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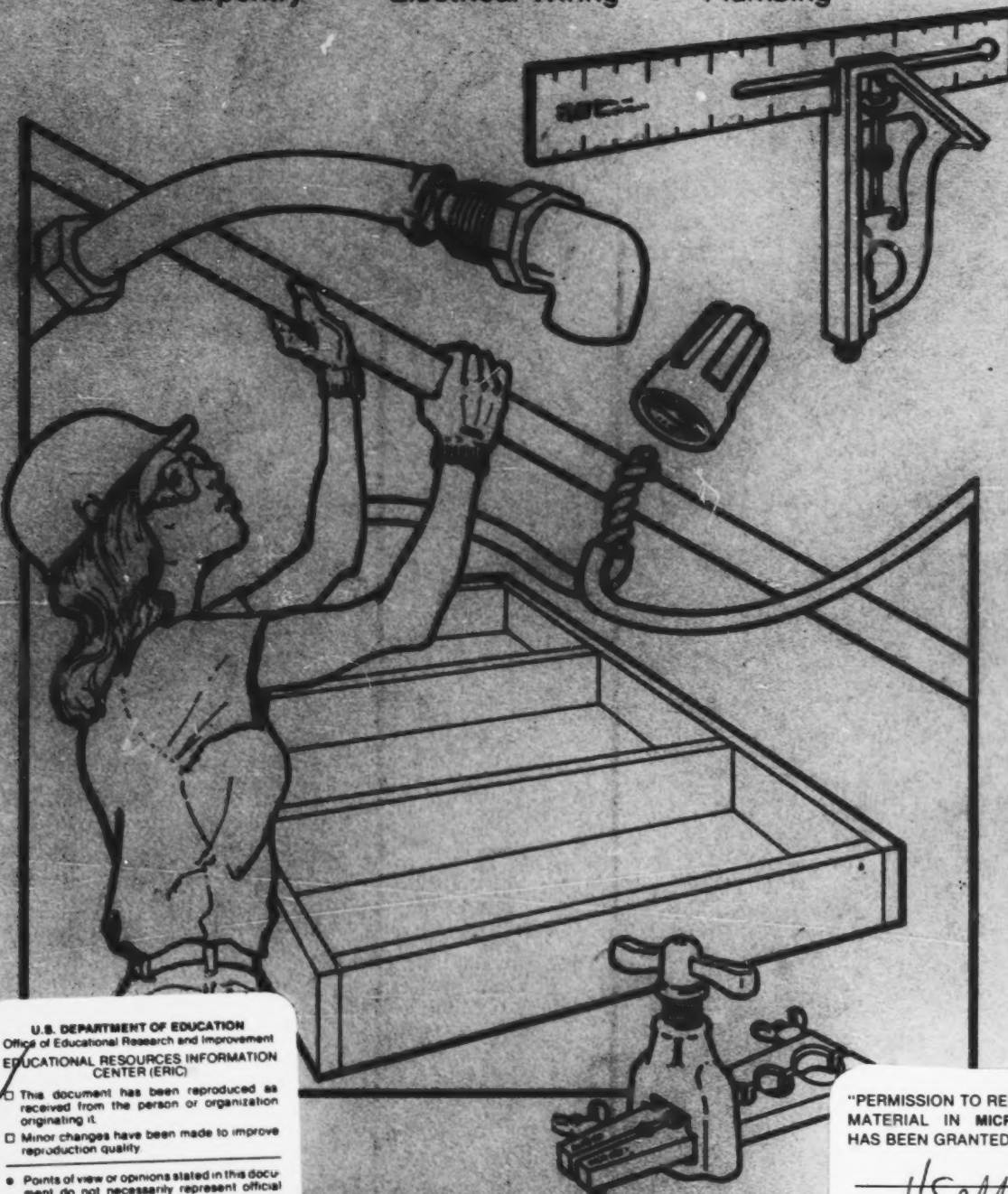
ABSTRACT

This curriculum guide contains 21 units of self-paced, self-contained instructional materials in the complete building trades curriculum. It is divided into vocational areas of carpentry, electrical wiring, and plumbing. The purpose of the curriculum is to provide minimum skills for disadvantaged and handicapped students entering mainstream classes and to supplement vocational skills of students in mainstream training programs. The materials are intended as hands-on procedural materials for the special needs student and as a resource and guideline to assist the instructor. Instructor's information includes handouts for additional student practice, answer keys for skill sheets and unit reviews, and teaching notes to the instructor. Each unit contains simplified line drawings, simplified text, and vocabulary development, and each unit is color-coded according to the following components: introduction, objectives, and student assessment; terms and equipment needed; steps of procedure; skill sheets (paper and pencil exercises to develop and reinforce the math skills necessary to perform the procedures in the unit); and student evaluation, including a performance checklist. Topics of units include careers and work attitudes, safety procedures, identifying carpentry tools, using building materials, cutting and measuring materials, framing, roofing, installing drywall, painting, wiring tools and their uses, electrical materials, safety rules in electrical wiring, roughing-in electrical circuits, making electrical connections, wiring a switch, wiring an outlet, installing light fixtures, plumbing materials and tools, and working with plastic, copper, and steel pipe. (YLB)

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Building Trades

Carpentry • Electrical Wiring • Plumbing



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Building Trades

Produced by
Instructional Materials Laboratory, University of Missouri-Columbia
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In Cooperation With
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Building Trades

Carpentry • Electrical Wiring • Plumbing

Preface

This Building Trades guide is a special needs project sponsored by the Missouri Department of Elementary and Secondary Education, Vocational Special Needs Education. This curriculum was developed to serve two primary purposes:

- to provide minimum skills for disadvantaged and handicapped students entering mainstream classes
- to supplement vocational skills of those students in mainstream training programs

Twenty-one units of self-paced and self-contained instructional materials are contained in the complete building trades curriculum. The guide is divided into vocational areas of carpentry, electrical wiring, and plumbing. Each unit contains simplified line drawings, simplified text, and vocabulary development. Each unit is color-coded as follows:

- White:** Introduction, Objectives, and Student Assessment - This page presents unit and specific objectives which the student must meet to successfully complete the unit. The introduction contains a brief motivational statement describing the purpose and content of the unit.
- Salmon:** Terms and Equipment - This section introduces new terms and equipment necessary for the student to understand and perform the tasks shown in the unit.
- Canary:** Steps of Procedure - This presents a verbal and illustrated step-by-step explanation of a given skill or task.
- Green:** Skill Sheets - These pages provide paper and pencil exercises to develop and reinforce the math skills necessary to perform the procedures in the unit.
- Pink:** Student Evaluation - These sheets are used by the instructor to evaluate student performance. Different forms of review, including matching, multiple-choice, and short answer exercises, are provided. Performance checklists are also included.

Curriculum material was developed as hands-on procedural materials for the special needs student and as a resource and guideline to assist the instructor. Responsibility of the instructor will be to adapt the material to suit a particular teaching/learning situation. This material can provide a basis for a variety of uses in a variety of special learning situations.

Instructor's information, located in the front of the book, contains handouts for additional student practice, answer keys for skill sheets and unit reviews, and teaching notes to the instructor.

Building Trades

Carpentry • Electrical Wiring • Plumbing

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Acknowledgments

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Notes to the Instructor

- Step 1: Read through the information in each unit before presenting it to the student.
- Step 2: Make sure all equipment to be used in each unit is available.
- Step 3: Prepare any handouts, visuals, or supplemental material to aid student learning activities.
- Step 4: Provide student with Introduction page.
- Step 5: Discuss tasks on Introduction page and give directions for completing the Are You Ready section.
- Step 6: Have student complete Introduction page.
- Step 7: If student elects to complete the Unit Review and Performance Checklist and does so to your satisfaction, have student proceed to the next unit. If student does not wish to do the exercises, proceed to the next step.
- Step 8: Discuss the Introduction page information with the student. At this time you can also discuss the Terms and Equipment lists.
- Step 9: Provide student with Steps of Procedure section.
- Step 10: Select a means to present the Steps of Procedure. (This will depend upon the capabilities of the student.)
 - a. Have student study information independently.
 - b. Go through the Steps of Procedure individually or as a group.
 - c. Go through the material as a group, then have students work independently.
- Step 11: Instructor can demonstrate procedures to the student or class.
- Step 12: Allow student time to practice the procedure. Individual judgement by the instructor will determine proper amount of time.
- Step 13: Have student complete all Skill Sheets for the unit. Skill Sheets are not necessarily to be used as an exam by the instructor, but as a self-evaluation by the student and as points of discussion for the class. Handouts can also be used for more practice.
- Step 14: When student is ready, use the Unit Review and Performance Checklist to evaluate student's performance for that unit.

Additional Suggestions

- Try a team approach when possible:
 - Beginning students can work together after instructor's demonstrations.
 - One student experienced with the procedure can work with a beginner.
- For non-readers or ESL students, audio-visuals of the lessons can be prepared.
- Review equipment with students whenever necessary.
- Exercises can be used as a pencil and paper exercise or in any way instructor feels will help to clarify the material.
- Additional modifications can be made to take care of other disadvantaged/handicapped conditions unique to your situation.
- Encourage students to study and practice outside of the classroom.
- Try to visit local building construction sites when possible.

Building Trades

Carpentry • Electrical Wiring • Plumbing

Student Names

WHAT THE STUDENT CAN DO

										Careers and Work Attitudes
										Safety Procedures
										Identifying Carpentry Tools
										Using Building Materials
										Cutting and Measuring Materials
										Framing
										Roofing
										Installing Drywall
										Painting
										Wiring Tools and Their Uses
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										Safety Rules in Electrical Wiring
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										Wiring a Switch
										Wiring an Outlet
										Installing Light Fixtures
										Plumbing Materials and Tools
										Working with Plastic Pipe
										Working with Copper Pipe
										Working with Steel Pipe

Building Trades
Careers and Work Attitudes

Unit Review

Directions: Read each of the tasks below and write which occupational area would do that task.

- | | Carpentry | Plumbing | Electrical Wiring |
|--------------------------|---|----------|-------------------|
| CARPENTRY | 1. Deliver a load of lumber and nails to a new home construction site. | | |
| PLUMBING | 2. Repair a leaky faucet in an apartment. | | |
| CARPENTRY | 3. Go to the building supply center and pick up 30 feet of plastic tubing for a vent pipe. | | |
| ELECTRICAL WIRING | 4. Go to the building supply center and pick up 200 feet of indoor wiring cable. | | |
| CARPENTRY | 5. Clean up the shop area and return hammers, saws, and nails to their storage cabinet. | | |
| ELECTRICAL WIRING | 6. Study construction plans for wiring a three-bedroom house. | | |
| CARPENTRY | 7. Measure and cut from a cabinet design to construct new kitchen cabinets for a remodel job. | | |
| ELECTRICAL WIRING | 8. Climb into an attic and check for a short in a fixture. | | |

Directions: Match the definition with the characteristic by writing the correct name in the blank space.

Follow Directions: Cooperation: Dependability: Enthusiasm: Initiative: Honesty:

- | | |
|--------------------------|--|
| INITIATIVE | 9. continuing on to the next job without being told to do so |
| ENTHUSIASM | 10. being eager to learn, showing an interest |
| COOPERATION | 11. getting along with your co-workers |
| FOLLOW DIRECTIONS | 12. giving your total attention to instructions |
| DEPENDABILITY | 13. being reliable |
| HONESTY | 14. not taking tools from work home with you |

Directions: Read each sentence below and write in the blank which work relations skill is described

Be Friendly Cooperate Respect Co-workers

- COOPERATE** 15. Jane had finished her work when she glanced over and saw Matt struggling to get the last set of fixtures packed for shipment. She thought Matt might be feeling a little worn out because she knew he had worked an extra shift to cover for another worker who was sick. Jane went to Matt's work station and help him finish by holding the box flaps open while he placed the light fixtures into the box.

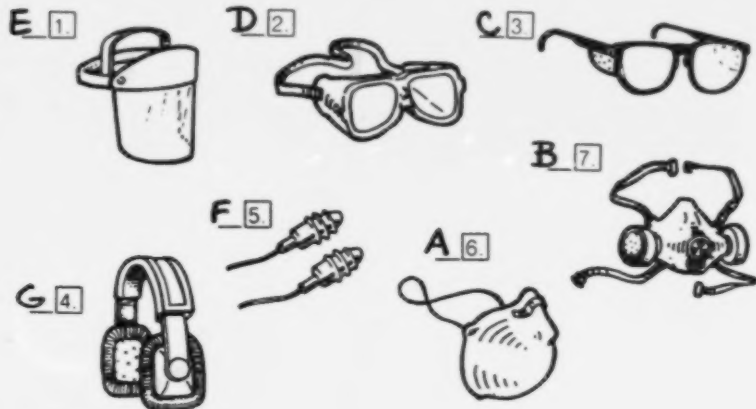
- BE FRIENDLY** 16. Terry did not know Ellen, the new employee, very well. But, on Monday, Terry noticed that she was quieter than she had been the week before. So, at break time, Terry sat down with Ellen and asked how her weekend had been. Ellen began talking about how busy she had been trying to move all of her belongings into a new apartment over the weekend. Terry reassured her and offered to help after work. As they were getting back to work, Ellen told Terry, "I was worried that I wouldn't fit in at this new job, but now I see that I'm going to like it just fine."

- RESPECT CO-WORKERS** 17. Sam did not quite know how to react to the plumber's assistant who was now working with him. Lee had recently moved into the community after leaving his home in a foreign country. Lee's English was not that good and his clothes were different from what Sam was used to seeing. And the food Lee brought to eat for lunch sometimes made Sam want to hold his nose! As time went on and as Sam began to talk more and more with Lee, Sam gained a new appreciation and understanding for his co-worker.

Building Trades
Safety Procedures

Unit Review

Write the letter of the correct safety device in the blank beside each picture



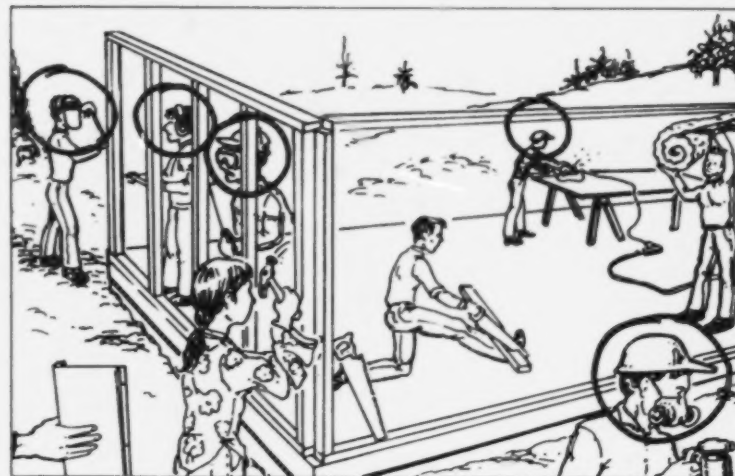
- | | |
|-----------------------|----------------|
| A. Particle mask | E. Face Shield |
| B. Organic Vapor Mask | F. Ear Plugs |
| C. Safety Glasses | G. Ear Phones |
| D. Goggles | |

Write the letter of the correct answer on the blank at the end of each question. Use these answers:

- | | |
|--------------------|-----------------|
| A. ear infections | B. shocks |
| C. loss of hearing | D. face shields |
| E. particle mask | F. overheating |

- C 8. What could happen if a person does not wear ear plugs while working around loud noises?
- D 9. What protection should be worn if there is a possibility of large pieces of wood chips hitting your face while sawing?
- E 10. What should be used to protect your lungs when working in dusty areas?
- B 11. What could happen if you use a power tool while you are standing in a wet area?
- F 12. What will happen if the wires in an extension cord are not heavy enough to carry the proper current?
- A 13. What can result from wearing dusty ear plugs?

Circle at least five **safe** practices in the construction site pictured below.



Building Trades - Carpentry
Identifying Carpentry Tools

Unit Review

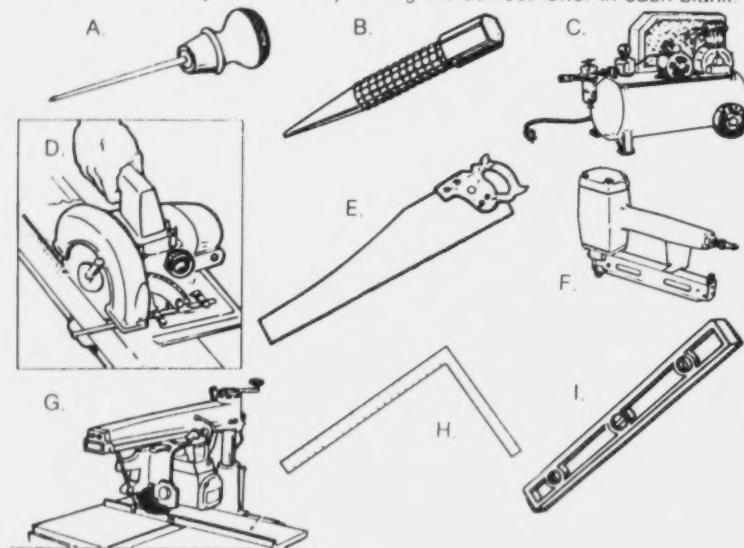
Directions: Match the tools with their uses by writing the correct letter in each blank.

- | | |
|--------------------------------|---|
| <u>B</u> 1. Hammer | A. Small tool used to check for squareness |
| <u>E</u> 2. Nailset | B. Nailing or pulling nails |
| <u>C</u> 3. Ripsaw | C. Cutting with the grain of lumber |
| <u>D</u> 4. Crosscut Saw | D. Cutting across the grain of lumber |
| <u>A</u> 5. Combination Square | E. Driving heads of finish nails below the surface of a board |
| <u>E</u> 6. T-bevel | A. Cuts materials such as sheetrock |
| <u>C</u> 7. Sheetrock Square | B. Measures the length of boards |
| <u>D</u> 8. Level | C. Laying out and marking sheetrock |
| <u>B</u> 9. Tape Measure | D. Tells if surface is level or plumb |
| <u>A</u> 10. Utility Knife | E. Can be set in different positions to transfer or check angles |
| <u>A</u> 11. Speed Square | A. Used for layout work and to cut help cut rafters with a circular saw |
| <u>B</u> 12. Awl | B. Marks points to be nailed or screwed |
| <u>D</u> 13. Radial Arm Saw | C. Portable power tool for cutting boards |
| <u>C</u> 14. Circular Saw | D. Used for cut-off and angle-cutting of boards |

Directions: Match each tool with its use by writing the correct letter in each blank.

- | | |
|------------------------------|---|
| <u>C</u> 15. Air Compressor | A. Marks a straight line between two points |
| <u>E</u> 16. Air Nail Driver | B. Drives staples with air pressure |
| <u>B</u> 17. Air Stapler | C. Supplies pressurized air to tools |
| <u>A</u> 18. Chalk Line | D. Used to lay out rafters or stairs |
| <u>D</u> 19. Framing Square | E. Drives nails with air pressure |

Directions: Identify each tool by writing the correct letter in each blank.



- | | |
|-----------------------------|-----------------------------|
| <u>H</u> 20. Framing Square | <u>E</u> 25. Ripsaw |
| <u>I</u> 21. Level | <u>A</u> 26. Awl |
| <u>B</u> 22. Nailset | <u>C</u> 27. Air Compressor |
| <u>C</u> 23. Radial Arm Saw | <u>E</u> 28. Air Nailer |
| <u>D</u> 24. Circular Saw | |

Building Trades - Carpentry
Using Building Materials

Unit Review

Directions: Match each grade of lumber with its most common use by putting the correct letter in each blank.

- | | |
|----------------------------|------------------------|
| <u>B</u> 1. Number 2 Grade | A. Utility Use |
| <u>A</u> 2. Number 3 Grade | B. Standard and Better |
| <u>C</u> 3. Number 4 Grade | C. Economy Use |

Directions: Match each type of lumber with its use by putting the correct letter in each blank.

- | | |
|---------------------------|---|
| <u>A</u> 4. Hardwood | A. Broadleaf wood used for flooring and furniture |
| <u>D</u> 5. Softwood | B. Thin plies of laminated lumber |
| <u>B</u> 6. Plywood | C. Sawdust and glue squeezed together under high temperature and pressure |
| <u>C</u> 7. Particleboard | D. Needle leaf or evergreen wood used for framing |

8. Calculate board feet for 3 - 2"x 6"x 8' pieces of lumber. Show your work.

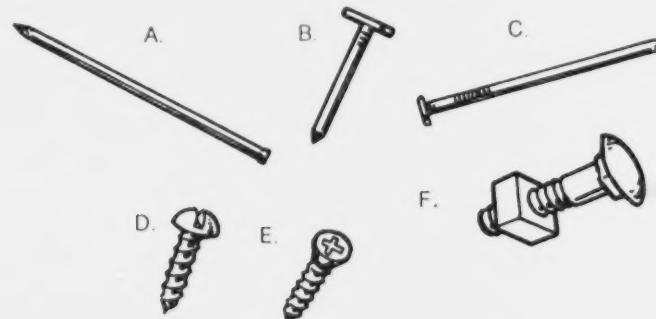
$$\frac{3(2 \times 6 \times 96)}{144} \quad \frac{3(1152)}{144} \quad \frac{3456}{144} \quad \text{OR } 24 \text{ BOARD FT.}$$

9. Calculate the square feet for a 10 foot x 10 foot room. How many 4' by 8' sheets of plywood will be needed to cover this area? Show your work.

$$\begin{aligned} \text{Square Feet in Room} &= \text{Length} \times \text{Width} \quad 10 \times 10 = 100 \\ \text{Square Feet in Sheet} &= \text{Length} \times \text{Width} \quad 4 \times 8 = 32 \\ \text{Number of Sheets} &= (\text{Area of Room}) / (\text{Area of Sheet}) \\ 100 \div 32 &= 3.2 \text{ SHEETS} \\ &\quad (\text{PURCHASE 4}) \end{aligned}$$

Directions: Match each illustration with its name by putting the letter in the correct blank space.

- | | |
|---------------------------|--|
| <u>C</u> 10. Common Nail | <u>F</u> 13. Carriage Bolt and Nut |
| <u>A</u> 11. Finish Nail | <u>E</u> 14. Flathead, Phillips Screw |
| <u>B</u> 12. Roofing Nail | <u>D</u> 15. Round Head, Single Slot Screw |



Directions: Match the type of material listed in the second column with its category by writing the correct letter in each blank.

- | | |
|--------------------------------------|---------------------------|
| <u>B</u> 16. Hardwood floor covering | A. Linoleum |
| <u>E</u> 17. Softwood floor covering | B. Oak Tongue and Groove |
| <u>F</u> 18. Sheet flooring | C. Foam Backed and Glued |
| <u>D</u> 19. Hard surface type | D. Grouted Mosaic |
| <u>A</u> 20. Soft flooring | E. Pine Tongue and Groove |
| <u>C</u> 21. Carpeting | F. 4'x 8' Plywood |

Directions: Match the methods of attachments to the wall and ceiling coverings by putting the correct letter in the blank.

- | | |
|-------------------------------|--|
| <u>B</u> 22. Coatings | A. Attached to wall studs and support themselves |
| <u>A</u> 23. Sheets | B. Applied over a supportive structure |
| <u>C</u> 24. Small Components | C. Small pieces glued or attached to a support |

Directions: Match the pictures to the types of exterior siding by putting the correct letter in each blank.

A 25. Shingles

D 26. Lap Siding (wood)

C 27. Metal Siding

B 28. Brick

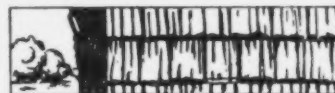
F 29. Stucco

G 30. Plastic/Vinyl Siding

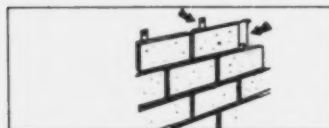
H 31. Boardsiding

E 32. Stone

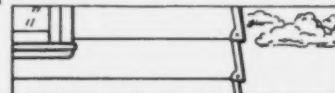
A. _____



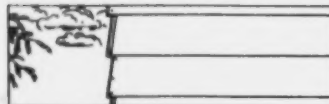
B. _____



C. _____



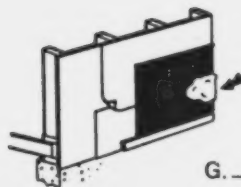
D. _____



E. _____



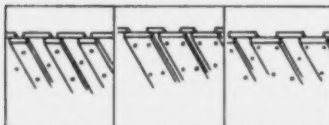
F. _____



G. _____



H. _____

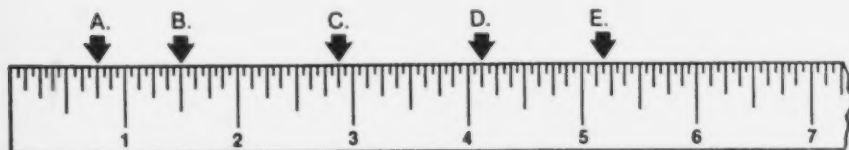


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Trades - Carpentry
Cutting and Measuring Materials

Skill Sheet 1
Reading Fractions on a Rule or Tape

Directions: Write the correct length in each blank.



1. A. = $\frac{3}{4}"$
2. B. = $1\frac{1}{2}"$
3. C. = $2\frac{7}{8}"$
4. D. = $4\frac{1}{2}"$
5. E. = $5\frac{3}{4}"$

Directions: Mark the correct distance on the lines below.

6. $3\frac{3}{4}$ inches



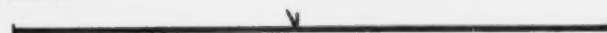
7. $1\frac{1}{4}$ inches



8. $3\frac{10}{16}$ inches



9. $2\frac{1}{2}$ inches



10. $2\frac{5}{8}$ inches



Building Trades - Carpentry
Cutting and Measuring Materials

Unit Review

Directions: Write the correct length for each of the measurements below in the blanks provided.



1. $\frac{3}{4}$ INCH
2. $1\frac{7}{8}$ INCHES
3. $3\frac{1}{8}$ INCHES
4. $3\frac{7}{16}$ INCHES
5. $4\frac{1}{2}$ INCHES

Directions: Match the word with its correct meaning by putting the correct letter in the blank space.

B 6. Level

A. a condition where corners are exactly 90°

A 7. Square

B. a condition of being exactly horizontal

C 8. Plumb

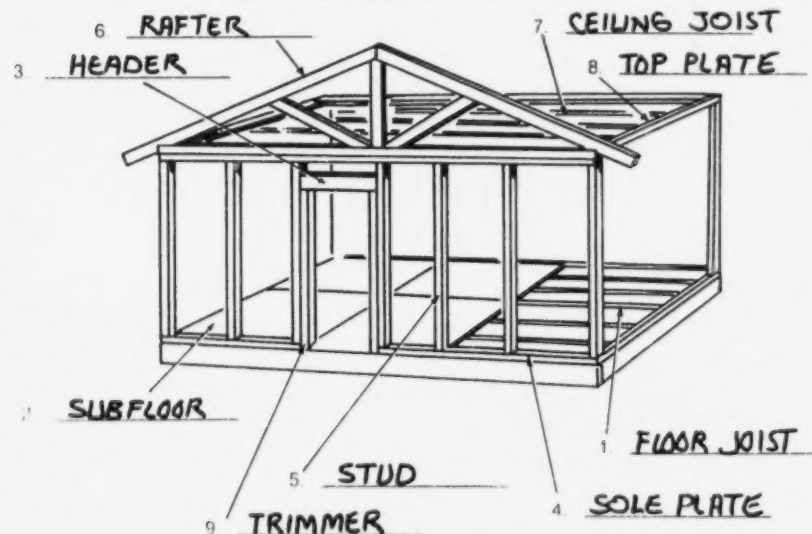
C. a condition of being exactly vertical (90° to the floor)

Building Trades - Carpentry
Framing

Unit Review

Directions: Identify the building frame members below by filling in the blanks. Use these words

STUD FLOOR JOIST SUBFLOOR TRIMMER TOP PLATE RAFTER
SOLE PLATE HEADER CEILING JOIST



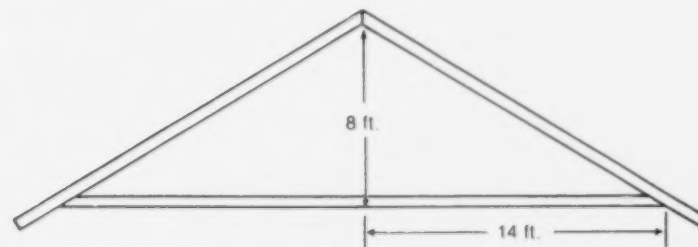
Directions: Put the following steps in their correct order of construction by putting numbers 1 through 7 in the blank lines.

- 1 A. Check joists and headers for squareness then mark crowns on each.
- 2 B. Layout and cut joists and headers with crowns up.
- 3 C. Mark off 16-inch centers on each header.
- 4 D. Nail end joists and floor joists to headers.
- 5 E. Check for squareness of constructed floor frame.
- 6 F. Chalk nail lines on subflooring and nail to floor frame.
- 7 G. Measure and cut subflooring.

Directions: Put the following construction steps in their correct order by putting numbers 1 through 8 in the correct blank.

- 1 H. Layout and cut blocks and 2 x 4's for corner studs and wall studs for first wall section.
- 4 I. Plumb first upright wall section and tack brace on for support.
- 2 J. Properly fit and nail first wall section together.
- 6 K. Stand up second wall section and attach to floor section and first wall section.
- 7 L. Attach top plates for additional support.
- 5 M. Construct second wall section.
- 3 N. Stand up first wall section and nail sole plate to the floor section.
- 8 O. Remove diagonal brace.

Directions: Find the pitch of the roof in the illustration below.



6.8"/14 PITCH

$$\begin{array}{r}
 8 \times 12 = 96 \\
 3 \overline{) 96.00} \\
 \underline{84} \\
 12 \\
 \underline{112} \\
 80 \\
 \underline{70} \\
 6.85
 \end{array}$$

Building Trades - Carpentry
Roofing

Skill Sheet 1
Estimating Roofing Materials

Directions: Determine how much roofing material is needed in each of the following problems.

1. One side of a roof is 22' x 50'. How many squares are needed to cover the flat part of the roof?

$$\frac{22 \times 50 = 1100}{100} = 11 \text{ SQUARES}$$

2. One side of a roof is 20' x 70'. How many squares are needed to cover the flat part of the roof?

$$\frac{20 \times 70 = 1400}{100} = 14 \times 2 \text{ OR } 28 \text{ SQUARES}$$

3. One side of a roof is 25' x 60'. How many squares are needed? (This time include the ridge too.)

$$\frac{25 \times 60 = 1500}{100} = 15 \times 2 = 30 \text{ SQUARES}$$

$$60/20 = 3 \text{ OR } \underline{1 \text{ SQUARE}}$$

31 SQUARES TOTAL

Roofing

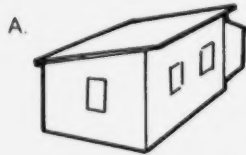
Unit Review

Directions: Match each word with its definition by writing the correct letter in each blank.

- | | |
|----------------------------|---|
| <u>E</u> 1. Bundle | A. A sloping roof |
| <u>D</u> 2. Square | B. A roof with no slope |
| <u>A</u> 3. Pitched Roof | C. Pieces of fiberglass or asphalt used to cover a roof |
| <u>B</u> 4. Flat Roof | D. Amount of shingles covering 100 square feet |
| <u>C</u> 5. Shingles | E. Amount of shingles in 1/3 of a square |
| <u>G</u> 6. Roll Felt | F. Materials placed on top of roll felt on flat roofs |
| <u>F</u> 7. Tar and Gravel | G. Layer of roofing material applied under the shingles |

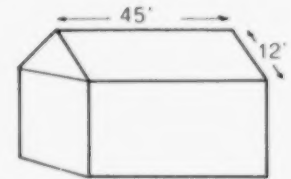
Directions: Match each picture with its name by writing the correct letter in each blank.

- D 8. Broadhead Galvanized Nail
B 9. Shingle
A 10. Flat Roof
C 11. Pitched Roof



Answer each problem in the space provided. SHOW YOUR WORK.

12. How many squares will be needed to cover the entire roof of this house (including the ridge)?



$$\frac{12 \times 45 = 540}{100} = 5.4$$

$$45/20 \text{ OR } \frac{2.3}{7.7}$$

(PURCHASE 14 SQUARES)

$$\begin{array}{r} 7.7 \text{ SQUARES} \\ 5.4 \text{ SQ (OTHER SIDE)} \\ \hline 13.1 \text{ SQUARES} \end{array}$$

13. One side of a roof measures 24' x 35'. How many squares will be needed to cover the entire roof (including the ridge)?

$$\frac{24 \times 35 = 8}{100} = 8.40 \text{ ONE SIDE}$$

8.40 OTHER SIDE

$$\frac{35}{20} \text{ OR}$$

$$\frac{1.75 \text{ RIDGE}}{18.55 \text{ SQUARES}}$$

(PURCHASE 19 SQUARES)

XVI

Building Trades - Carpentry
Installing Drywall

Answers:

1. $16' \times 32' = 512$ square feet
One $4' \times 8'$ sheet = 32 square feet
 $512 \div 32 = 16$ $4' \times 8'$ sheets needed

2. A room $16' \times 32'$ has 2 walls $8' \times 16'$ $2 \times 8' \times 16' = 256'$
2 walls $8' \times 32'$ $2 \times 8' \times 32' = 512'$
1 ceiling $16' \times 32'$ $16' \times 32' = 512'$
Total = 1280 square feet
a) $4' \times 8' = 32$ square feet in sheet in room

$1280 \div 32 = 40$ $4' \times 8'$ sheets needed

3. A room has 4 walls: 2 walls $8' \times 12'$ $2 \times 8' \times 12' = 192$
2 walls $8' \times 24'$ $2 \times 8' \times 24' = 384$
576 square feet

Since 12' sheets would have no waste and the least joints, $4' \times 12'$ sheets should be used.

$4' \times 12' = 48$ square feet

$576 \div 48 = 12$ sheets needed for the walls

Building Trades - Carpentry
Installing Drywall

Unit Review

Directions: Match the following terms with their correct definitions by writing the correct letters in the blanks.

- | | |
|--|---|
| <u>C</u> 1. Mudding | A. Places where pieces of sheetrock meet |
| <u>D</u> 2. Regular gypsum board | B. Supports the ceiling sheetrock while it is being applied |
| <u>E</u> 3. Water resistant drywall | C. Applying a mixture of plaster compound and water to cover joints and nails |
| <u>G</u> 4. Type X (Fire Code) drywall | D. Generally used on walls and ceilings |
| <u>E</u> 5. Sheetrock | E. Another name for drywall |
| <u>B</u> 6. Deadman | F. Sheetrock used in kitchens and bathrooms |
| <u>A</u> 7. Joints | G. Fire resistant sheetrock |

Directions: Circle the letter of the best answer.

8. Which is not another name for drywall?
a. Sheetrock c. Plasterboard
b. Gypsum board d. Wallboard
e. Chipboard
9. What usually happens when a nail breaks through the paper on the sheetrock?
a. The nail is crooked.
b. The head can pull completely through the sheet.
c. The board will move.
10. How many layers of joint compound are usually applied?
a. 2 c. 4
b. 3 d. 5

Directions: Calculate the answers to the following problems. Show your work and circle your answers.

11. How many $4' \times 12'$ sheets of sheetrock are needed to cover a ceiling that is $12' \times 24'$?

$12 \times 24 = \frac{288}{48}$ OR 6 SHEETS

12. A room is 10 feet long, 16 feet wide, and 8 feet high. How many sheets are needed for the room (all for walls and the ceiling)? What would be the best size for the sheets?

$$8 \times 10 = 80$$

$$10 \times 16 = 160$$

$$\begin{array}{r} 8 \times 16 = 128 \\ \hline 208 \\ \times 2 \\ \hline 416 \end{array}$$

$$4 \times 16 \text{ SHEETS} = 64$$

$$\frac{416}{64} = 6.5 \text{ SHEETS - WALLS}$$

$$\frac{160}{64} = 2.5 \text{ SHEETS - CEILING}$$

$$\begin{array}{l} 9 \text{ SHEETS} \\ (4' \times 16' \text{ SIZE}) \end{array}$$

xviii

Painting

Unit Review

Directions: Match the correct name of the painting equipment with its picture by putting the correct letter in the blank space. Choose from these words.

- A. Roller C. Brush E. Paint Pail
B. Stepladder D. Drop Cloth F. Paint Pads

1. C



4. E



2. A



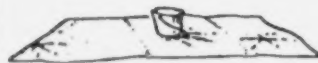
5. F



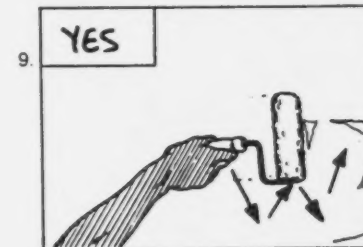
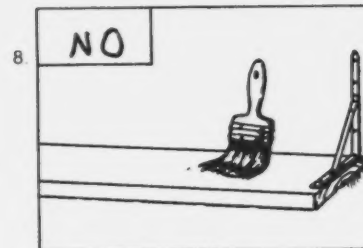
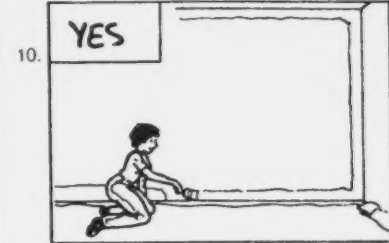
3. B



6. D



Directions: Write YES by the pictures that show the correct painting method. Write NO by those that do not.



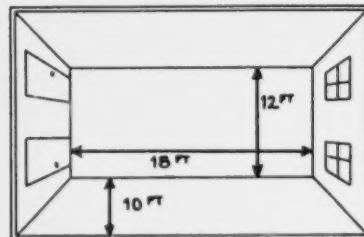
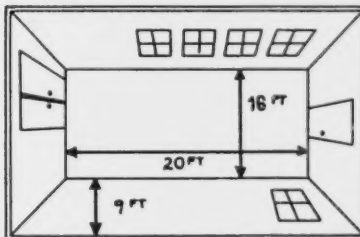
Directions: Match the type of paint with its correct definition by putting the correct letter in the blank space.

- B 13. Latex Paint
 A 14. Oil Paint

- A. An oil-base paint
B. A water-base paint

Directions: Calculate the area for each of the following rooms. Show your work.

If a gallon of paint covers approximately 400 square feet of area, how many gallons of paint will you need to buy to paint each room? Show how you figure this.



15. TOTAL SQUARE FEET
TO BE PAINTED:

510

16. PAINT NEEDED IN
GALLONS:

2 GAL.

$$20 + 16 = 36 \times 9 = 324$$

$$324 \times 2 = 648$$

$$\begin{array}{r} 648 \\ 5 \times 15 = 75 \quad - 75 \\ 3 \times 21 = 63 \quad - 63 \\ \hline 510 \end{array}$$

17. TOTAL SQUARE FEET TO
BE PAINTED:

528

18. PAINT NEEDED IN
GALLONS:

2 GAL.

$$18 + 12 = 30 \times 10 = 300$$

$$300 \times 2 = 600$$

$$\begin{array}{r} 600 \\ 2 \times 15 = 30 \quad - 30 \\ 2 \times 21 = 42 \quad - 42 \\ \hline 528 \end{array}$$

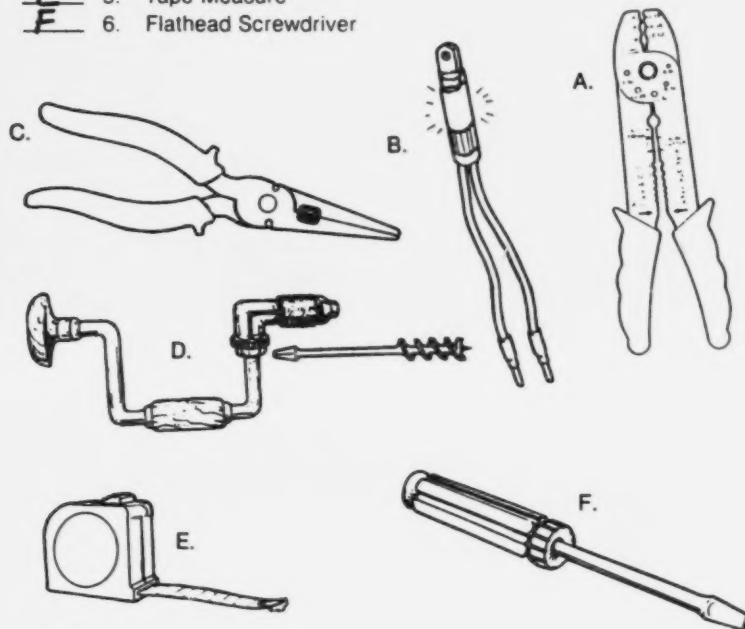
Building Trades · Electrical Construction
Wiring Tools and Their Uses

Unit Review

Name: _____

Directions: Match the following tools with their correct names.

- A 1. Wire Stripper/Cutter
B 2. Test Light
C 3. Long Nose Pliers
D 4. Hand Brace and Bit
E 5. Tape Measure
F 6. Flathead Screwdriver

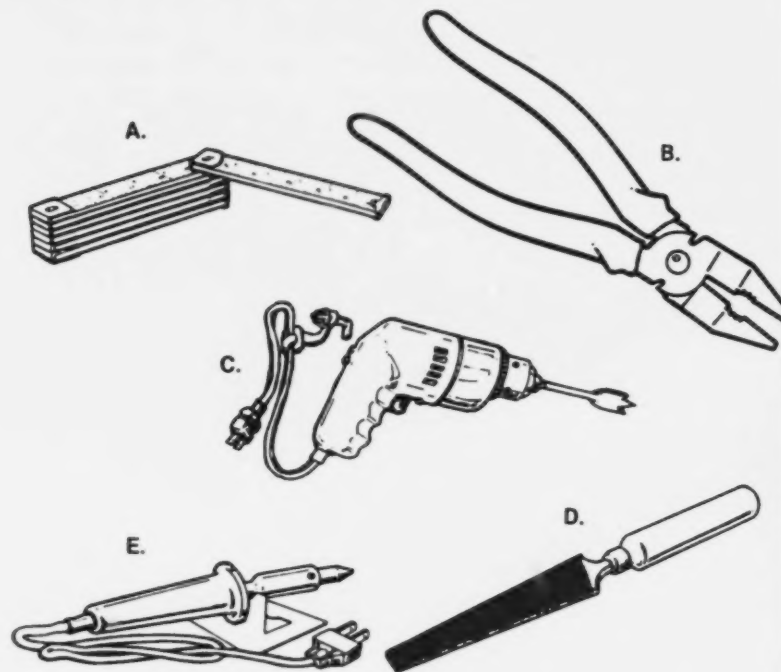


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Building Trades · Electrical Construction
Wiring Tools and Their Uses

Directions: Match the following tools with their correct uses.

- A 7. Used when rigid measuring device is needed
D 8. Used to smooth sharp ends of conduit
E 9. Used to melt solder for wire splices
C 10. Power tool used to make holes in studs and joists
B 11. Used to cut and twist electrical wires



Building Trades - Electrical Construction
Wiring Tools and Their Uses

Directions: Circle the letter of the best tool for each task:

1. To cut electrical wire and twist wires together:
a. cable ripper b. wire cutter/stripper **c. side cutting pliers**
2. To check for electric voltage in an outlet:
a. screwdriver **b. test light** c. long nose pliers
3. To bend wires and hold small parts in place:
a. side cutting pliers b. soldering iron **c. long nose pliers**
4. To make holes in studs for wiring:
a. brace and bit b. screwdriver c. wire cutter/stripper
5. To slice insulation on non-metallic cable:
a. soldering iron **b. cable ripper** c. wire cutter/stripper

xxii

Electrical Materials

Use the following prices to calculate the cost of materials

cable	\$.14 a foot
connector	\$.25 ea
duplex receptacle	\$1.39 ea
rectangular box	\$.89 ea
cover plate	\$.39 ea
15 ampere circuit breaker	\$19.87 ea
switch	\$1.39 ea
porcelain fixture	\$2.79 ea
octagon box	\$1.29 ea
wire nut	\$.07 ea

Problem 1: What would be the cost of adding an outlet to a circuit if you need the following materials?

16 feet of cable	$.14 \times 16 = 2.24$
2 romex connectors	$.25 \times 2 = .50$
1 duplex receptacle	$1.39 \times 1 = 1.39$
1 rectangular box	$.89 \times 1 = .89$
1 cover plate	$.39 \times 1 = .39$
Total	$= 5.41$

Problem 2: What would the materials cost for this job?

15 ampere circuit breaker	$19.87 \times 1 = 19.87$
80 ft of cable	$.14 \times 80 = 11.20$
2 switches	$1.39 \times 2 = 2.78$
4 receptacles	$1.39 \times 4 = 5.56$
2 porcelain fixtures	$2.79 \times 2 = 5.58$
2 octagon boxes	$1.29 \times 2 = 2.58$
6 rectangular boxes	$.89 \times 6 = 5.34$
16 romex connectors	$.25 \times 16 = 4.00$
8 wire nuts	$.07 \times 8 = .56$
6 cover plates	$.39 \times 6 = 2.34$
Total	$= 59.81$

Problem 3: What is the cost of materials for this job?

Replace 4 porcelain fixtures	$2.79 \times 4 = 11.16$
Replace 2 switches	$1.39 \times 2 = 2.78$
Total	$= 13.94$

Skill Sheet Two

Calculating Cost of Wire Per Foot

To figure the cost per foot divide the cost by the number of feet.

Example: Baker Electric Supply sells 100' rolls of 14-2 with ground cable for \$8.99.

$$\begin{array}{r} 100 \overline{) 8.99} \\ \underline{8.00} \\ .990 \\ \underline{.900} \\ .090 \end{array}$$

Your cost is almost \$.09 per foot.

Figure the cost of one foot of wire for each of the following problems:
[Round off the answer to the next higher cent (8 1/2 to 9).]

- 14-2 indoor cable with ground

25'	\$2.39	1 ft = $.10$
50'	\$4.59	1 ft = $.09$
100'	\$7.95	1 ft = $.08$
250'	\$15.00	1 ft = $.06$
- 12-2 indoor cable with ground

25'	\$2.96	1 ft = $.12$
50'	\$5.73	1 ft = $.11$
100'	\$11.23	1 ft = $.11$
250'	\$21.95	1 ft = $.09$
- UL Listed Outdoor 14-2 wire

25'	\$2.99	1 ft = $.12$
50'	\$5.89	1 ft = $.12$
100'	\$11.76	1 ft = $.12$
250'	\$21.95	1 ft = $.09$
- UL Listed Outdoor 12-2 wire

25'	\$3.99	1 ft = $.16$
50'	\$7.88	1 ft = $.16$
100'	\$15.67	1 ft = $.16$
250'	\$28.67	1 ft = $.11$

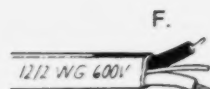
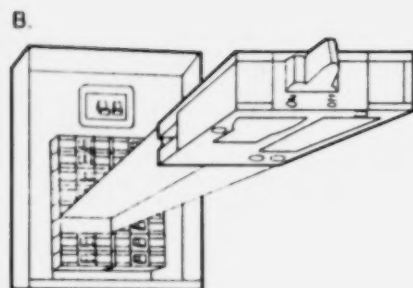
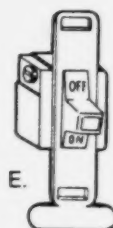
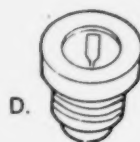
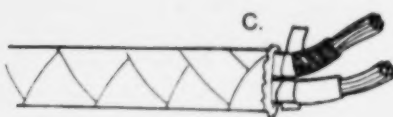
Building Trades - Electrical Construction
Electrical Materials

Unit Review

Name: _____

Match the names with the correct objects.

- C 1. Service Entrance Cable
F 2. Nonmetallic Sheathed Cable
A 3. Light Fixture
E 4. Light Switch
D 5. Fuse
B 6. Circuit Breaker



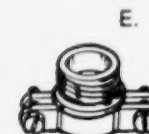
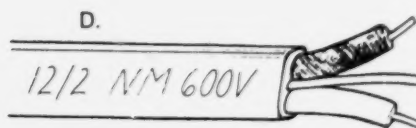
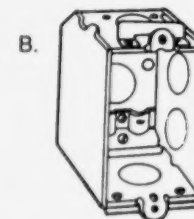
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Building Trades - Electrical Construction
Electrical Materials

Name: _____

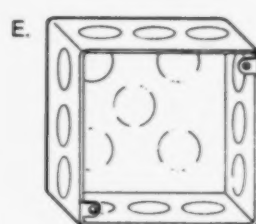
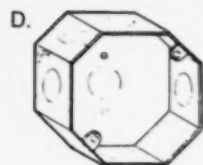
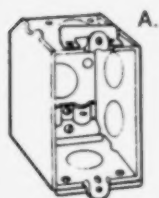
Match the objects with their correct uses.

- B 7. Box used for a switch or receptacle and its wiring connections.
C 8. A safety device which stops the flow of electricity when a circuit overheats.
E 9. Device used to hold non metallic cable to a junction box.
A 10. Tubing that is used to protect electrical wiring.
D 11. Cable for indoor and dry location use.

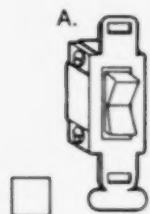


Match each object with what it does.

- D 17. Octagonal shaped box for ceiling lamps
A 18. Rectangular box used for wall switches or outlets
E 19. Square box for more than one outlet or switch
B 20. Common receptacle for 110 voltage (AM radio)
C 21. Common receptacle for 220 voltage (clothes dryer)



22. Check the box next to the toggle switch.



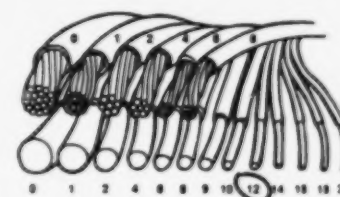
Building Trades - Electrical Construction

Electrical Materials

Name: _____

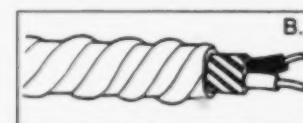
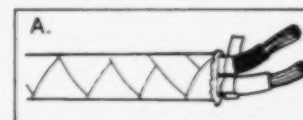
Using What You Have Learned

12. Circle the number indicating the most common size of wire used in house wiring.



Match the cable with its correct name.

- C 13. Non Metallic Sheathed Cable
B 14. Flexible Armored Cable
A 15. Service Entrance Cable



16. Draw an arrow pointing to the ground wire in the NM sheath cable above.

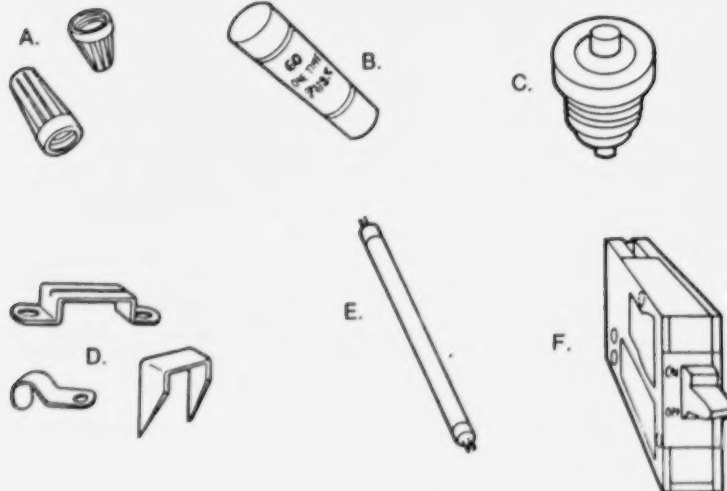
xxvi

23. Check the most common NM cable connector.



Match the picture to its purpose or job.

- A 24. Plastic caps used to insulate and protect wire splices
- D 25. Used to hold electrical cables in position
- B 26. Electrical safety device which burns out when overheated
- C 27. Safety device with a button that pops out to break the circuit when it becomes overheated
- F 28. An electrical safety device that 'trips' when overheated and can be reset
- E 29. Lighting fixture used because it used less electricity than standard bulb fixture.



Building Trades - Electrical Construction
Safety Rules in Electrical Wiring

Skill Sheet 1

Calculating Watts, Volts, and Amperes

Use this formula to help you calculate the answers.

1. You have 1800 watts. You have 120 volts. How many amps? 15 AMPS
2. You have 120 volt service with a 20 amp fuse. How many watts? 2400 WATTS
3. You have 115 volt service (figure used in the Electrical Code) and a 15 amp fuse. How many watts? 1725 WATTS
4. You have 2070 watts and 115 volt service. How many amps? 18 AMPS
5. You have 15 amps and 1800 watts. How many volts? 120 VOLTS
6. You have 15 amps and 1725 watts. How many volts? 115 VOLTS

Building Trades - Electrical Construction
Safety Rules in Electrical Wiring

Skill Sheet 2

Name: _____

Using What You Have Learned

Circle 'T' if the statement is true, or 'F' if the statement is false.

- ☐ T ☐ F 1. Overloading a circuit can cause a fire.
- ☐ T ☐ F 2. A fire may start when bare parts of wires touch when they are carrying electricity.
- ☐ T ☐ F 3. It is important that you report accidents to your instructor, no matter how small they seem to be at the time.
- ☐ T ☐ F 4. The ends of bare wires should not be handled carelessly.
- ☐ T ☒ F 5. It is safe to do electrical hookups while standing in water or on a damp floor.
- ☐ T ☐ F 6. Grounded plugs are safer to use than ungrounded ones.
- ☐ T ☐ F 7. Insulated handles on tools help to prevent electrical shock.
- ☐ T ☒ F 8. You can usually do electrical wiring tasks even if you have some questions about how the job is done.
- ☐ T ☐ F 9. You can check an electrical wire with a test light to find out whether it has current or not.
- ☐ T ☐ F 10. Never work on an electrical circuit until you have found and disconnected the main circuit breaker.
- ☐ T ☐ F 11. Safety glasses protect your eyes when cutting, stripping, and installing wiring.
- ☐ T ☒ F 12. If a circuit requires a 15 amp fuse, you may safely put in a larger size.
- ☐ T ☐ F 13. Different wire sizes have different uses.
- ☐ T ☒ F 14. A three prong receptacle without a ground wire attached is as safe as one with a ground wire attached.
- ☐ T ☒ F 15. Splices can be made safely anywhere along a circuit without a junction box.
- ☐ T ☒ F 16. It is important to check electrical work carefully before connecting it to the power source.

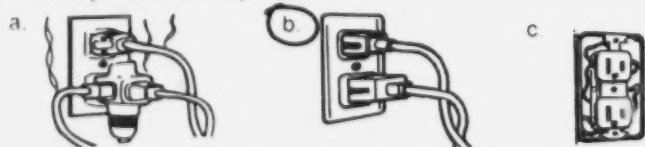
Building Trades - Electrical Construction
Safety Rules in Electrical Wiring

Unit Review

1. You should wear safety glasses when
 - a. cutting wiring
 - b. stripping and installing wiring
 - ☒ c. both a and b
2. Tool handles should be:
 - ☒ a. insulated
 - b. steel
 - c. aluminum
3. The first thing you should do when working with electricity is:
 - a. test for live wires
 - ☒ b. disconnect the power
 - c. install the right size fuse
4. Never install a three prong receptacle without:
 - a. soldered splices
 - ☒ b. a ground wire
 - c. armored cable
5. Which wire could cause a fire when connected to #14 wire?
 - a. #14 wire
 - b. #12 wire
 - ☒ c. #18 wire
6. Which picture shows a proper connection?



7. Identify the safe receptacle:

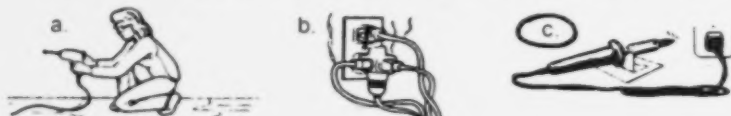


8. A set of rules you must use for safe wiring is:
 - ☒ a. electrical code
 - b. U. L. listings
 - c. Ohm's laws
9. The best procedure to follow when you are not sure is
 - a. use the trial and error method
 - ☒ b. ask your supervisor
 - c. not do the task at all
10. Which will result in a fire?
 - a. a plug with a grounded prong
 - b. making connections in a junction box
 - ☒ c. allowing bare wires carrying current to touch
11. What should you do if you get scratched by a wire?
 - ☒ a. report the accident to your instructor
 - b. ignore the accident since it is not serious
 - c. put a band-aid on the scratch and forget it
12. Draw an arrow pointing to the safety feature on the plug.



13. The reason it is important to handle bare wires carefully is:
 - a. your fingerprints will cause bad connections
 - ☒ b. the sharp ends may cut or scratch you
 - c. bare wires are always hot

14. Circle the picture showing a safe use of an electrical appliance.



15. When is it safe to touch the tip of a soldering iron?

- ☒ a. it is not safe
- b. when it is unplugged
- c. when it is warming up

16. Before you connect your work to a power source you should:

- a. check your work carefully
- b. have your supervisor check your work

☒ c. both of the above

17. Follow safety rules and know what you are doing when working with electricity because:

- a. improper wiring can cause fires
- b. electricity can injure or kill unsafe workers

☒ c. both of the above

18. Before you touch an electrical wire:

- a. put on insulated gloves
- ☒ b. make sure it is not a live wire with a tester
- c. read the electrical code

Building Trades - Electrical Construction
Safety Rules in Electrical Wiring

Unit Review

Match the term with it's meaning:

- 3 A. Speed or rate of electric flow
- 4 B. Amount of resistance
- 2 C. Electric pressure
- 1 D. Amount of electricity used - total work done

1. Watts(w)

3. Amperes(I)

2. Volts(E)

4. Ohms(R)



Write the formula for each:

E. Watts

$$W = I \times E$$

F. Volts

$$E = W / I$$

G. Amperes

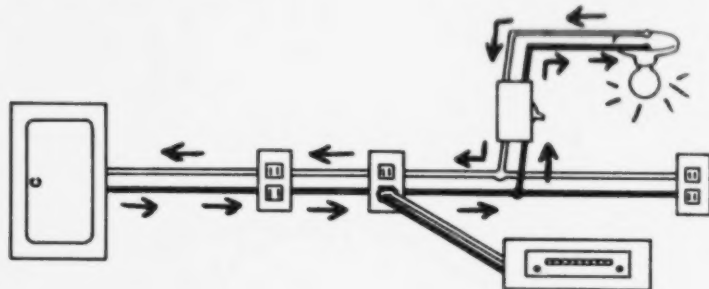
$$I = W / E$$

Building Trades - Electrical Construction
Roughing-In Electrical Circuits

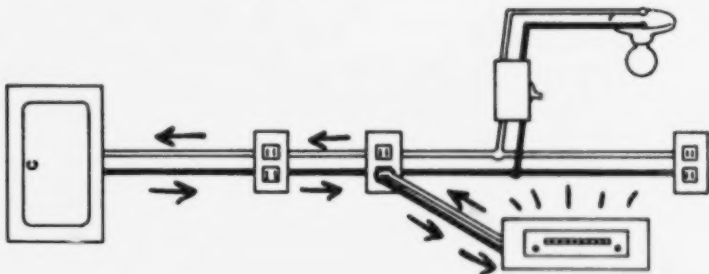
Skill Sheet One
Roughing-In Electrical Circuits

Draw arrows to show the path of the current in the circuits shown below

A. When the switch is on



B. When the radio is turned on



Building Trades - Electrical Construction
Roughing-In Electrical Circuits

Unit Review

Use the following words to complete the sentences.

circuit ground
 black overload
 white

- The BLACK (hot) wire carries electricity to the light
- The GROUND wire directs live current into the ground.
- The WHITE (neutral) wire returns the current to a ground wire at the service entrance.
- For electricity to do work, it must complete a CIRCUIT.
- Too much electricity for the wire is an OVERLOAD.

Circle the letter of the best answer.

- One 15 amp. circuit is enough for 600 square feet of flooring if it is used for:
 - ☒ lighting
 - small appliances
 - large appliances
- The minimum number of 20 amp. small appliance circuits in a kitchen should be:
 - one
 - ☒ two
 - three
- The symbol that shows a switch is:
 - ☐ Ⓢ
 - ☐ Ⓢ
 - ☒ Ⓢ
- The symbol that shows a receptacle is:
 - ☒ Ⓢ
 - ☐ Ⓢ
 - ☐ Ⓢ

10. The symbol that shows a light is:

- ☒ a. 
- b. 
- c. 

11. Rough-in wiring is done in a(n)

- a. finished basement
- ☒ b. open framework for an addition
- c. outdoor underground wiring

12. Draw the wires to connect this circuit. Draw arrows to show the current flow.



13. "Run a wire" means to:

- ☒ a. to push or pull cable
- b. to jog
- c. to remove

14. What should happen when a circuit is overloaded?

- a. the lights flash
- b. an alarm rings
- ☒ c. the fuse blows

15. The source for branch circuits is the:

- ☒ a. breaker panel
- b. generator
- c. utility pole

16. What size fuse or breaker should you use for a 15 amp. circuit?

- ☒ a. 15 amp.
- b. 20 amp.
- c. 30 amp.

17. What material offers the least resistance to electricity?

- a. skin
- ☒ b. copper
- c. porcelain

18. In NM cable the grounding wire is:

- a. black
- b. white
- ☒ c. bare copper

19. A branch circuit supplies electricity to:

- a. the whole house
- ☒ b. a part of the house
- c. the breaker box

20. When wiring a house, you will follow a:

- ☒ a. wiring plan
- b. a map
- c. a written set of directions

Building Trades • Electrical Construction
Making Electrical Connections

Unit Review

Directions: Choose the best answer by circling the letter in front of the word that makes the statement correct.

1. To make a solderless connection use a:
a. pigtail splice
☒ b. wire nut
c. cable connector
2. An electrical connection made by twisting two wires together is a:
a. junction box
b. cable connector
☒ c. pigtail splice
3. Which tools are used to make electrical connections?
☒ a. wire stripper/cutter, side cutting pliers, and soldering iron
b. screwdriver, cable ripper, and drill
c. long nose pliers, hammer, and continuity tester
4. The main reason to make a splice is:
a. to save wire
☒ b. to join shorter wires
c. to make wires stronger
5. Splices should always be contained in:
a. open framework
b. fixtures
☒ c. electrical boxes
6. If the wire stripper nicks the wire, what happens?
☒ a. the wire is weakened and may break
b. nothing will happen
c. the wire won't bend
7. What opening on the wire stripper would you pick for Number 14 wire?
a. 10
b. 12
☒ c. 14
8. What tool do you use to twist wires in a splice?
a. wire stripper
☒ b. pliers
c. vise

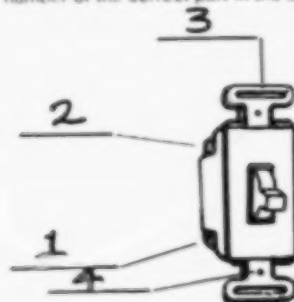
9. What direction do you turn a wire nut to twist it on?
☒ a. clockwise
b. counterclockwise
c. a and b
10. What type of solder should you use to solder a splice?
a. acid core solder
b. solid solder
☒ c. rosin flux core solder
11. Heat the pigtail splice by placing the soldering iron against:
a. the side of the splice
☒ b. the bottom of the splice
c. the top of the splice
12. Apply solder to:
a. the side of the splice
b. the bottom of the splice
☒ c. the top of the splice
13. The main danger when soldering is:
☒ a. the hot soldering iron burning you
b. the splice catching on fire
c. the solder melting the wires
14. Tape wrapped around the soldered splice:
a. acts as insulation
b. helps prevent the splice from breaking
☒ c. both a and b
15. When soldering a splice, excess wire should be:
a. cut off
☒ b. bent back
c. twisted together

Wiring a Switch

Unit Review

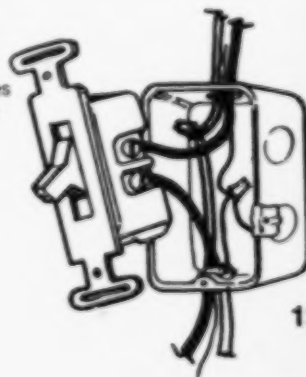
Directions: On the picture of a switch, put the number of the correct part in the blank by that part.

- 1 terminal screw
- 2 grounding screw
- 3 mounting screw slots
- 4 holes for mounting cover plate



Directions: Choose the best answer to make a true statement in each of the following sentences.

5. What color of wire should be fastened to the brass terminal?
 - a. bare wire
 - b. white wire
 - ☒ c. black wire
6. The two white wires are:
 - a. connected to the brass screws
 - ☒ b. joined together with a wire nut
 - c. fastened to the switch box
7. Which tools do you use to install a switch?
 - ☒ a. wire strippers, pliers, and screwdriver
 - b. cable ripper, drill, and hacksaw
 - c. voltage tester, pocket knife, and hammer
8. Draw white wires, black wires, and ground wires to show how to correctly connect a single pole switch.



XXXX

Wiring an Outlet

Unit Review

Directions: Circle the letter in front of the word or statement that makes the sentence true.

1. Connect the black wires to the:
 - a. aluminum screws
 - ☒ b. brass screws
 - c. green screw
2. Connect the white wires to the:
 - ☒ a. aluminum screws
 - b. brass screws
 - c. green screw
3. Connect the ground wire to the:
 - a. aluminum screws
 - b. brass screws
 - ☒ c. green screw
4. The six inch copper wires are called:
 - ☒ a. pigtails
 - b. short connectors
 - c. grounding terminals
5. A tool used to tighten wires to the outlet is a:
 - a. pair of pliers
 - b. wire stripper
 - ☒ c. screwdriver
6. Bend the wire loops in the direction:
 - ☒ a. that the screws turn
 - b. opposite the way the screws turn
 - c. that the wall faces
7. The long nose pliers are used to:
 - a. twist the ground wires together
 - b. attach wire nuts
 - ☒ c. bend the wire ends into loops

8. Parallel circuits have:
 - a. only one path for current to flow
 - ☒ b. more than one path for current to flow
 - c. two receptacles for each circuit
9. Outlets are secured to the boxes with:
 - a. wire splices
 - ☒ b. screws
 - c. nails
10. What is one of the last steps in wiring an outlet?
 - a. stripping the wire
 - b. connecting the ground wires with a wire nut
 - ☒ c. attaching the cover plate

Installing Light Fixtures

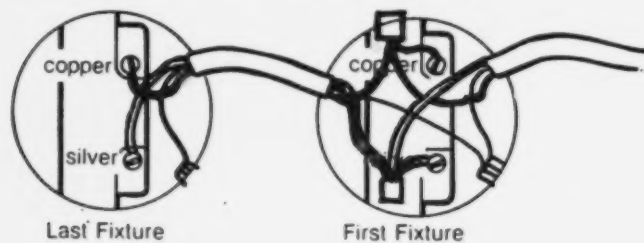
Unit Review

Directions: Circle the letter of the best answer.

1. The most visible part of a wiring system is the:
 - a. switch
 - ☒ b. electric light fixture
 - c. octagon box
2. To wire the fixtures you used:
 - a. duplex polarity wiring
 - b. series wiring
 - ☒ c. parallel wiring
3. Light fixtures are controlled by a:
 - a. junction box
 - ☒ b. switch
 - c. receptacle
4. To prepare the octagon boxes for cable you should:
 - a. clean them with steel wool
 - b. remove the flange
 - ☒ c. remove the knockouts
5. Putting cable between the two octagon boxes and through the knockouts is:
 - ☒ a. running the cable
 - b. fine finishing work
 - c. parallel wiring
6. To slit the outside cable insulation, use a:
 - a. wire stripper
 - b. side cutting pliers
 - ☒ c. cable ripper
7. To fasten the cable to the octagon boxes, use:
 - a. electrical tape
 - ☒ b. cable connectors
 - c. solder

8. A pigtail is a:
 - a. tool
 - b. long curled piece of wire
 - ☒ c. short piece of wire
9. To check if the current path is broken, use a:
 - ☒ a. continuity tester
 - b. light bulb
 - c. pigtail
10. What color of wire should be attached to the brass fixture screw?
 - a. white
 - ☒ b. black
 - c. copper (ground)
11. What color of wire attaches to the silver (aluminum) fixture screw?
 - ☒ a. white
 - b. black
 - c. copper (ground)
12. To make wire loops, use:
 - ☒ a. long nose pliers
 - b. side cutting pliers
 - c. wire strippers
13. To hold wires together, twist them and use:
 - a. masking tape
 - ☒ b. a wire nut
 - c. a cable connector
14. The safety device used in electrical work to carry away the excess current is:
 - ☒ a. ground wire
 - b. transformer
 - c. parallel circuits
15. To fasten the fixture to the box, use:
 - a. wood screws
 - b. sheet metal screws
 - ☒ c. mounting screws

17. Complete the drawing below by drawing lines to show where wires should be connected. Label the color of each wire. Also draw a ☐ to show where each wire nut should be placed.

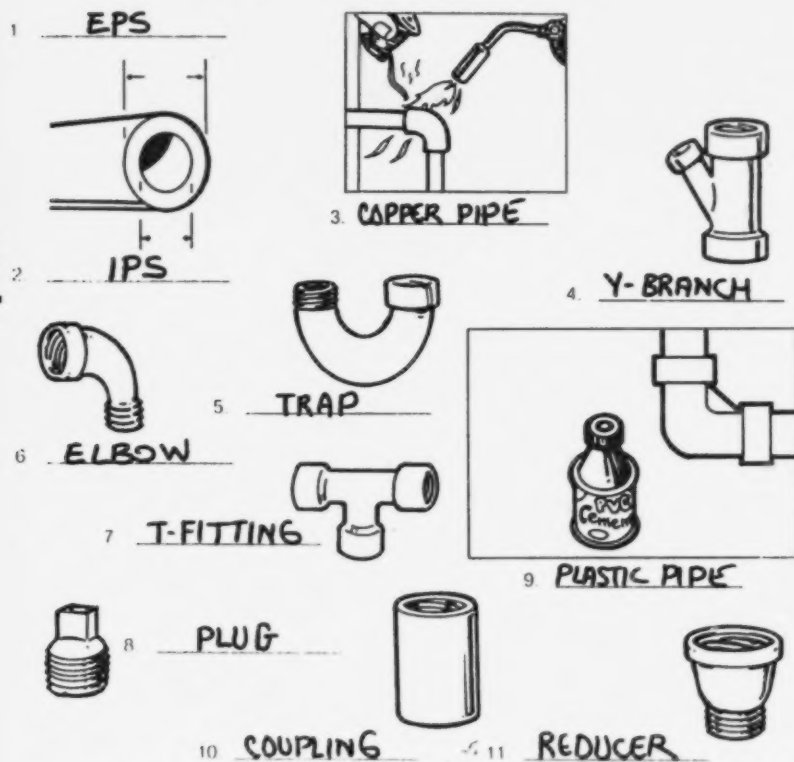


Building Trades - Plumbing
Plumbing Materials and Tools

Unit Review

Directions: Identify the following pieces by putting the correct name in the blank space. Choose from these words

T-FITTING TRAP Y-BRANCH IPS EPS REDUCER ELBOW PLUG
COUPLING COPPER PIPE PLASTIC PIPE



Building Trades - Plumbing
Plumbing Materials and Tools

E. Calculate the Cost of Materials for a Given Plumbing System

Your first plumber's apprentice job is to estimate the cost of adding a sink to a room by tapping into an existing system. The plumber has made a list of materials and fixtures necessary to complete the job.

Your task is to add these costs for materials and fixtures, and the labor cost for you and the plumber.

Listed beside each item below is its cost (including tax) from the local plumbing supply store. Add these figures for your materials and fixtures cost and put that total in the space provided.

For labor costs, you make \$14.00 per hour and the plumber makes \$32.00 per hour. Add the cost for the two of you for 5 hours labor each. Put that total in the space provided.

MATERIALS AND FIXTURES

Sink Assembly

- Pedestal Sink.....\$35.50
- Hot/Cold Faucet.....\$25.99
- Trap.....\$6.39
- Chrome Supply Lines -
2 at \$2.50
- Chrome Shut-off Valves -
2 at \$3.75

Supply Line (Copper Tubing)

- 1/2" Rigid (M) Tubing -
40 Ft.....50¢ per foot
- 90° Fitting.....2 at 18¢
- Coupling.....4 at 21¢
- Caps.....2 at 18¢
- T-Fittings.....4 at 32¢

Drain Line (ABS Pipe)

- ABS Pipe -
28 Ft.....46¢ per foot
- Couplings.....2 at 44¢
- 45° Fittings.....2 at \$1.99
- T-Fitting.....\$1.99
- Y-Branch Fitting.....\$3.25
- Tap Adapter.....\$1.10
- Slack Flashing.....\$3.60

Miscellaneous

- Solder (1 lb.).....\$2.40
- Flux......79¢
- Propane.....\$2.20
- Plumber's Straps.....6 at \$2.70
- Other (sandpaper, putty, drain cap
glue, etc.).....\$8.00

SHOW YOUR WORK ON THE BACK

\$160.49

TOTAL MATERIALS
AND SUPPLIES COST

\$70.00

LABOR COST FOR
YOU

\$160.00

LABOR COST FOR
PLUMBER

\$230.00

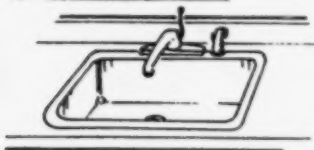
TOTAL LABOR COST

TOTAL COST FOR MATERIALS, SUPPLIES, AND LABOR \$ 390.49

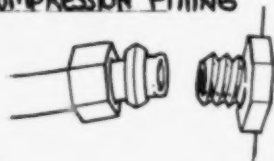
Directions: Match the name with its correct illustration. Choose from the following words

FLARED FITTING SINK LAVATORY COMPRESSION FITTING WATER CLOSET

12. SINK



13. COMPRESSION FITTING



14. FLARED FITTING



15. WATER CLOSET



16. LAVATORY

Directions: Match the correct word with its definition.

B 17. Globe Valve

A. Valve must be completely opened or completely closed

A 18. Gate Valve

B. Valve used to shut-off high water pressure

C 19. Check Valve

C. Valve which allows water to run in one direction only by preventing a backflow

E 20. Cartridge Faucet

D. Faucet with a stem and washer to control flow and mix of water

D 21. Stem Faucet

E. A cartridge in this faucet controls the flow and mix of water

Directions: Match the illustration with its correct name by writing the name in the correct blank.

PIPE DIE PIPE TAP FLARING TOOL

28. PIPE DIE



29. FLARING TOOL



30. PIPE TAP



Building Trades - Plumbing
Working with Plastic Pipe

Unit Review

Directions: Match the equipment with their uses by writing the correct letter in each blank.

- | | |
|----------------------------------|--|
| <u>C</u> 1.Cleaning Solvent | A. Removes rough spots and burrs from cut ends of pipe |
| <u>D</u> 2.Pipe Solvent | B. Used to cut plastic pipe |
| <u>B</u> 3.Plastic Tubing Cutter | C. Cleans pipe ends and fittings before gluing |
| <u>A</u> 4 Round File | D. Glues and seals plastic pipe and fittings |

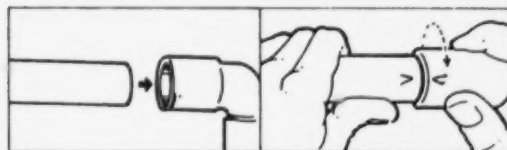
Directions: Circle the letter of the best answer.

5. The correct measurement to cut a pipe would be:
 - a. the exact measurement between the fittings.
 - b. the pipe measurement plus extra length to fit inside one of the fittings.
 - c. the pipe measurement plus extra length to fit inside both fittings.
6. An important step after cutting pipe is to:
 - a. Remove the burrs from the end.
 - b. bevel the pipe end.
 - c. use an emery cloth.
 - d. all of these answers.
7. What usually happens if there is an incomplete seal at the pipe joint?
 - a. the pipe will break
 - b. the pipe will leak
 - c. the joint will be stronger
8. Extreme caution should be taken around solvent fumes because:
 - a. fumes can melt the plastic pipe.
 - b. fumes prevent a tight-fitting joint.
 - c. fumes are harmful when inhaled.

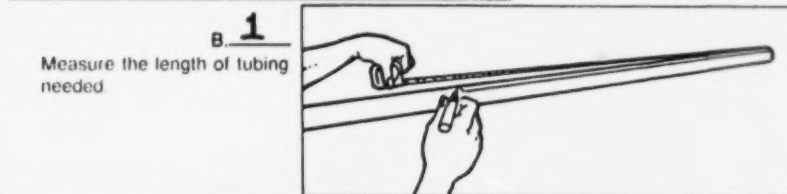
Building Trades - Plumbing
Working with Copper Pipe

Unit Review

Directions: Put the illustrations in their correct order by numbering them 1 through 6 in the blank spaces.



A. 5
Push pipe into fitting and align



B. 1
Measure the length of tubing needed.



C. 2
Cut the copper pipe.



D. 3
Ream the ends of the pipe.



E. 6
Heat the tube and fitting and apply the solder.



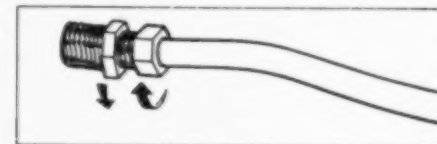
F. 4
Apply soldering paste.

64

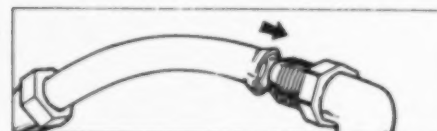
19

Directions: Write the name of the fitting in each of the illustrations below.

1. UNFLARED COMPRESSION



2. FLARED COMPRESSION



xlii

65

20

Building Trades - Plumbing
Working with Steel Pipe

Unit Review

Directions: Match each tool with its use by writing the correct letter in each blank.

- B 1. pipe reamer
C 2. pipe vise
E 3. file
F 4. tri square
D 5. pipe cutter
G 6. pipe threading die
A 7. wrench

- A. Loosens or tightens joints
B. Removes inside burr from cut pipes
C. Holds pipes securely while cutting, reaming or threading
D. Cuts pipe cleanly
E. Marks place to cut pipe
F. Checks squareness of cut
G. Cutting piece used to thread pipe

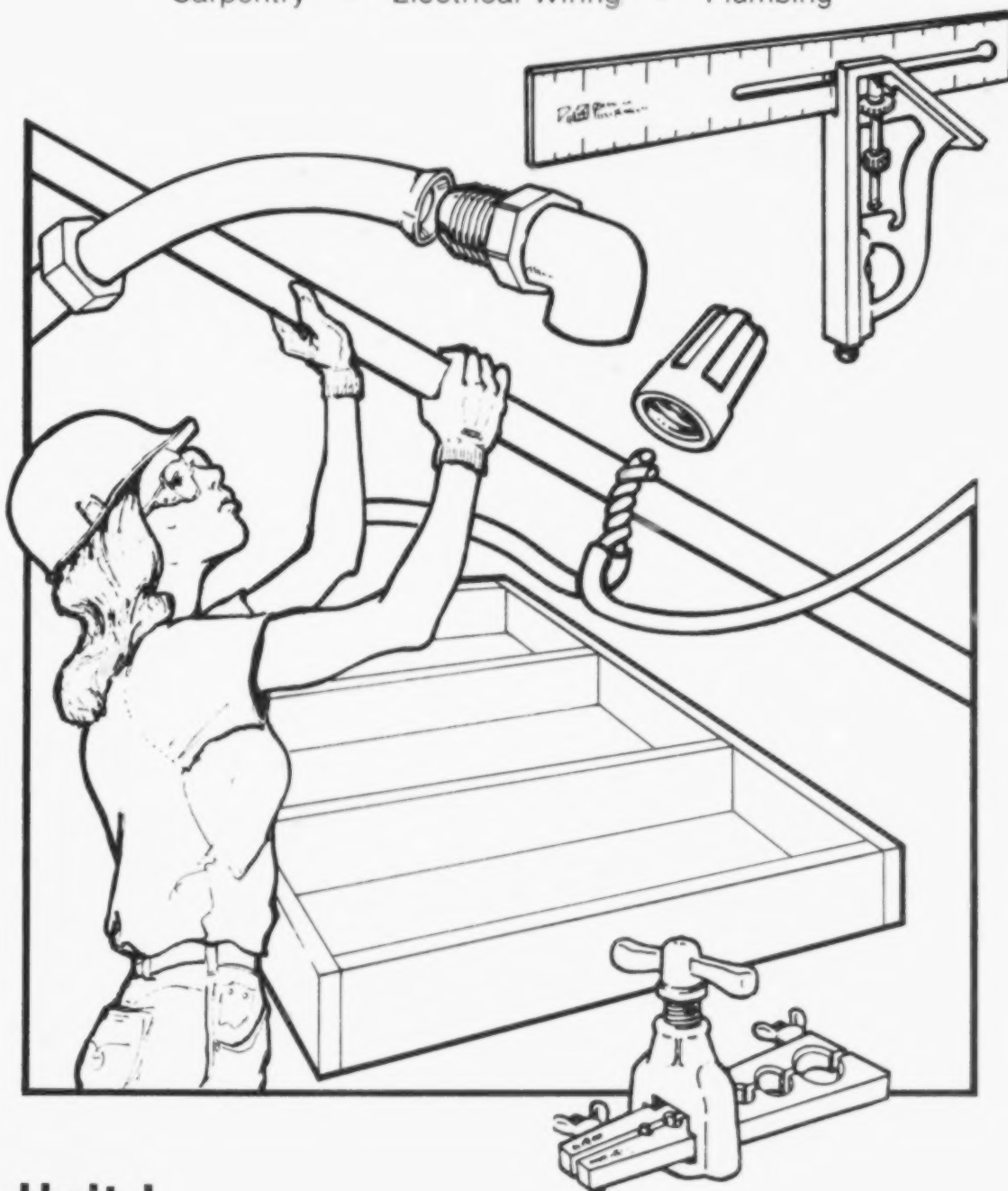
Directions: Circle the letter of the best answer.

8. What would happen if a pipe cutter is tightened too tightly against the pipe?
a. The pipe will warp.
b The pipe will bend.
c. The pipe will not be cut straight.
9. Why must a cut pipe be reamed?
a to remove the sharp edges and burrs
b. to make new threads
c. to straighten the pipe
10. What is "threading a pipe"?
a cutting grooves in the end of the pipe
b. cutting the pipe to the proper length
c. smoothing the burrs and rough edges on a pipe
11. When connecting steel pipe on which end do you apply the joint compound?
a the male thread end
b. the female thread end
c. the male and female thread ends

12. Place the procedures for working with steel pipe in the order they should be done by using A for the first step, B for the second step, C for the third step, and D for the fourth step.

- A Select correct tools to do the job
C Ream and thread the steel pipe
D Connect steel pipe pieces
B Measure and cut pipe to proper length

Building Trades
Carpentry • Electrical Wiring • Plumbing



Unit I

Careers and Work Attitudes

Instructional Materials Laboratory • University of Missouri-Columbia

Building Trades

Careers and Work Attitudes

Careers and Work Attitudes

After studying this unit, you will be able to:

1. Identify jobs in the building trades areas of carpentry, plumbing, and electrical wiring.
2. Identify characteristics of a good employee.
3. List three ways to create good relations with co-workers.

Check the Statement that Fits You Best

☐

I can do these tasks and want to go through the Performance Checklist.



SEE YOUR INSTRUCTOR

☐

I want to study the information in this unit before I do the Performance Checklist.



TURN PAGE AND BEGIN

Building Trades
Careers and Work Attitudes

Introduction

Millions of people are employed in building trades. Those employed include carpenters, electricians, plumbers, supervisors, surveyors, contractors, technicians, drafters, architects, and engineers. Education and skills needed vary widely in these occupations but experience is very important.

Building trades craftspersons, including plumbers, electricians, and carpenters, make up America's largest group of skilled workers. Therefore, jobs are available in the building trades industry; but you must show special skills and interest, through education and experience, to have a career in building trades.



You can be the most skilled craftsperson in the industry but if you can't get along with your bosses and co-workers, you won't be able to keep a job. Poor attitude and bad work habits are the main reasons people lose their jobs; not because they can't do the work. This unit will look at some of the characteristics you need to help make your building trades career a success.

Building Trades
Careers and Work Attitudes

A. Identifying Jobs in the Building Trades

Carpentry:

Carpentry is the largest single skilled occupation. To become a carpenter, you must go through educational and experience levels starting as an apprentice and working to a journeyman carpenter. Many related jobs provide opportunities to gain experience.

1. **Carpenter's Helper:** works with an experienced carpenter. Primary duties are to arrange or move tools, materials, and equipment; clean and prepare work areas; measure and cut lumber; and select proper tools. This is an entry level job.



2. **Framing Carpenter:** assembles construction framing on-site or as pre-fabricated construction. Framing carpenters must be able to read building plans, measure, cut, and assemble large sections of construction.

3. **Form Builder:** builds wood forms in which concrete is poured for structure foundations or concrete structures.



4. **Finish Carpenter:** does detail or finish work on structures. This person has training and experience in installing doors and windows, floors, window and door trim, paneling, and specialty construction. The finish carpenter must be good at precision measuring (a math skill), cutting, and assembling.



5. **Cabinet Maker:** makes and installs cabinets, bookshelves, furniture, and other household needs. This person must be good at precision measurement (math), cutting, and assembling; and must know characteristics of different woods.

6. **Building Supply Worker:** works at a lumber yard or building supply center. Duties include driving trucks; stocking, inventorying or ordering materials, and working with the public through sales or delivery.



7. **Building Maintenance Person:** does minor remodeling and repair for buildings and institutions.



Plumbing:

Plumbing is all of the pipes, fixtures, and valves that carry water and gas through a structure. To do a good job, a plumber must have knowledge and experience in plumbing codes and basic drainage principles. A plumber usually does all phases of plumbing from the on-site inspection, to rough-in, to final assembly and checking for leaks. Plumbers work through different apprentice levels. Some types of plumbing jobs are:

1. **Plumber's Helper:** works as an assistant to a journeyman plumber. Main responsibilities are to select and assemble equipment and tools; measure and cut pipe; and clean work areas.



2. **New Construction Plumber:** installs water and gas systems in new-home or building construction. This work begins at the start of a building project and lasts through the installation of the fixtures and accessories as the structure is completed.
3. **Maintenance Plumber:** performs general maintenance and repair of fixtures and lines including leaking faucets, dripping showers, broken water lines, and more.

4. **Plumbing Supply Worker:** works in a plumbing sales business or a building supply center. This person must be able to work with the public and be able to stock and inventory supplies. Knowledge of what is available in the plumbing market is also important.



Electrical Trades

Electricians are responsible for all the wiring to bring electricity into new construction. They must study the electrical plans, set boxes in proper locations, and make sure enough electricity is available for the structure. Because they work with electricity, electricians must always be safety conscious because electricity can be very dangerous.

Electrical work is done in new construction wiring, remodel wiring, and electrical maintenance. Some of the electrical trades are:

1. **Electrician's Helper:** works as an assistant to a journeyman electrician. The helper's main responsibilities are to select and assemble tools for the electrician, measure and cut wiring, assist the electrician, and clean and maintain the work area or job site.



2. **Electrician:** usually does all phases of electrical work from job estimating, through rough-in and final connections to the main distribution panel. Electricians work in new construction, remodeling, and maintenance work.

3. **Electrical Supply Worker:** works in an electrical sales business or a building supply center. This person must have knowledge of different electrical supplies and equipment, be able to work with the public, and be able to stock and inventory supplies.



Building Trades

Careers and Work Attitudes

B. Characteristics of a Good Employee

Working well with others is the key to success on the job. You can learn to work well with others by developing a good attitude. Attitudes you develop now will carry over into your job and social life so it is important for you to develop positive attitudes.

Changing a bad attitude into a good attitude takes time and effort but the reward is a happier life at home, school, and work.



A good attitude is shown in many positive employee characteristics at work. You may not think so, but your employer and co-workers notice these characteristics.

1. Cooperation:

The person who pays your wages has the right to expect you to cooperate and get along with your co-workers. This includes getting your work done and being friendly and respectful toward others. Accepting constructive criticism is part of cooperation.



2. Follow Directions:

Employees must be able to follow directions. Following directions will make it easier to learn your job and the skills associated with your job. If you don't understand directions, ask your supervisor to explain them more clearly. If you must read or listen to the instructions, give them your total attention.



3. Honesty:

Employees must be honest with their employer. This means getting to work on time, working until quitting time, and giving an honest day's work. Honesty also is shown by not taking company materials, supplies, or products home with you!



4. **Enthusiasm:**

Being eager to learn, interested in your work and excited about your job shows you have enthusiasm. Ask questions, show an interest, some companies offer classes for employees who want to improve their skills. Employees who continue to learn are more likely to be promoted.



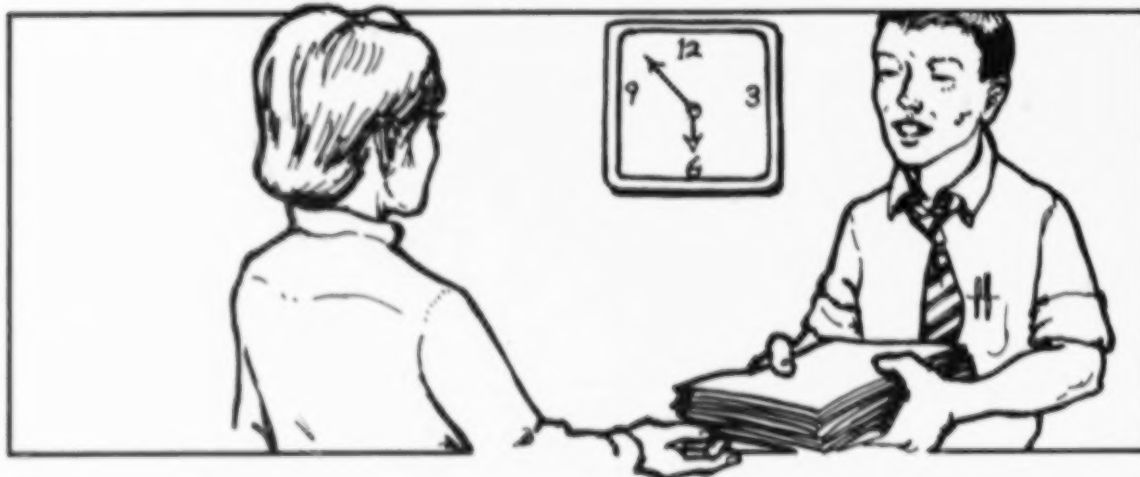
5. **Initiative:**

An employee who shows initiative does not have to be told over and over again what to do. When you finish one job, continue on to the next one. Show initiative but also use good judgement; don't take on more than you can do!



6. **Dependability:**

Being dependable means that your employer can rely on you to be at work and to finish your assigned work on time. Your boss will know that when you are given a task, it will get done. There will be times you are ill and can't make it to work. Call your employer and explain why. If you are planning a vacation, tell your boss as early as possible. This shows you are dependable.



Building Trades

Careers and Work Attitudes

C. Three Ways to Create Good Relations with Co-workers

Almost every job involves working with other people, so try to develop good working relationships with your co-workers.

You will probably work with many different kinds of people. You may not like all of them as friends, but it is important that you get along with them.



1. Be Friendly:

It is easier to like someone who is friendly. You will find that you'll get along better with co-workers if you smile and greet them by name. Show an interest in their work and be cheerful! Nobody likes a grump.

2. Cooperate:

Cooperation is working together with other people. It is working with others as a team to get the job done. Part of cooperation is dependability - your co-workers must be able to rely on you to do your part.

3. Respect Co-workers:

Everyone is different in some way. This difference may be physical or it may be the way a person reacts to something that happens. Differences are what makes people interesting, so accept the fact that people are different and respect those differences. Be positive and look for good qualities in people.

SEE YOUR INSTRUCTOR

Building Trades
Careers and Work Attitudes

Unit Review

Directions: Read each of the tasks below and write which occupational area would do that task.

- | | Carpentry | Plumbing | Electrical Wiring |
|-------|---|----------|-------------------|
| _____ | 1. Deliver a load of lumber and nails to a new home construction site. | | |
| _____ | 2. Repair a leaky faucet in an apartment. | | |
| _____ | 3. Go to the building supply center and pick up 30 feet of plastic tubing for a vent pipe. | | |
| _____ | 4. Go to the building supply center and pick up 200 feet of indoor wiring cable. | | |
| _____ | 5. Clean up the shop area and return hammers, saws, and nails to their storage cabinet. | | |
| _____ | 6. Study constructions plans for wiring a three-bedroom house. | | |
| _____ | 7. Measure and cut from a cabinet design to construct new kitchen cabinets for a remodel job. | | |
| _____ | 8. Climb into an attic and check for a short in a fixture. | | |

Directions: Match the definition with the characteristic by writing the correct name in the blank space.

Follow Directions: Cooperation: Dependability: Enthusiasm: Initiative: Honesty:

- | | |
|-------|--|
| _____ | 9. continuing on to the next job without being told to do so |
| _____ | 10. being eager to learn; showing an interest |
| _____ | 11. getting along with your co-workers |
| _____ | 12. giving your total attention to instructions |
| _____ | 13. being reliable |
| _____ | 14. not taking tools from work home with you |

Directions: Read each sentence below and write in the blank which work relations skill is described.

Be Friendly

Cooperate

Respect Co-workers

- _____ 15. Jane had finished her work when she glanced over and saw Matt struggling to get the last set of fixtures packed for shipment. She thought Matt might be feeling a little worn out because she knew he had worked an extra shift to cover for another worker who was sick. Jane went to Matt's work station and help him finish by holding the box flaps open while he placed the light fixtures into the box.
- _____ 16. Terry did not know Ellen, the new employee, very well. But, on Monday, Terry noticed that she was quieter than she had been the week before. So, at break time, Terry sat down with Ellen and asked how her weekend had been. Ellen began talking about how busy she had been trying to move all of her belongings into a new apartment over the weekend. Terry reassured her and offered to help after work. As they were getting back to work, Ellen told Terry, "I was worried that I wouldn't fit in at this new job, but now I see that I'm going to like it just fine."
- _____ 17. Sam did not quite know how to react to the plumber's assistant who was now working with him. Lee had recently moved into the community after leaving his home in a foreign country. Lee's English was not that good and his clothes were different from what Sam was used to seeing. And the food Lee brought to eat for lunch sometimes made Sam want to hold his nose! As time went on and as Sam began to talk more and more with Lee, Sam gained a new appreciation and understanding for his co-worker.

Building Trades
Careers and Work Attitudes

Performance Checklist

Student _____ has successfully performed the following steps of procedure.

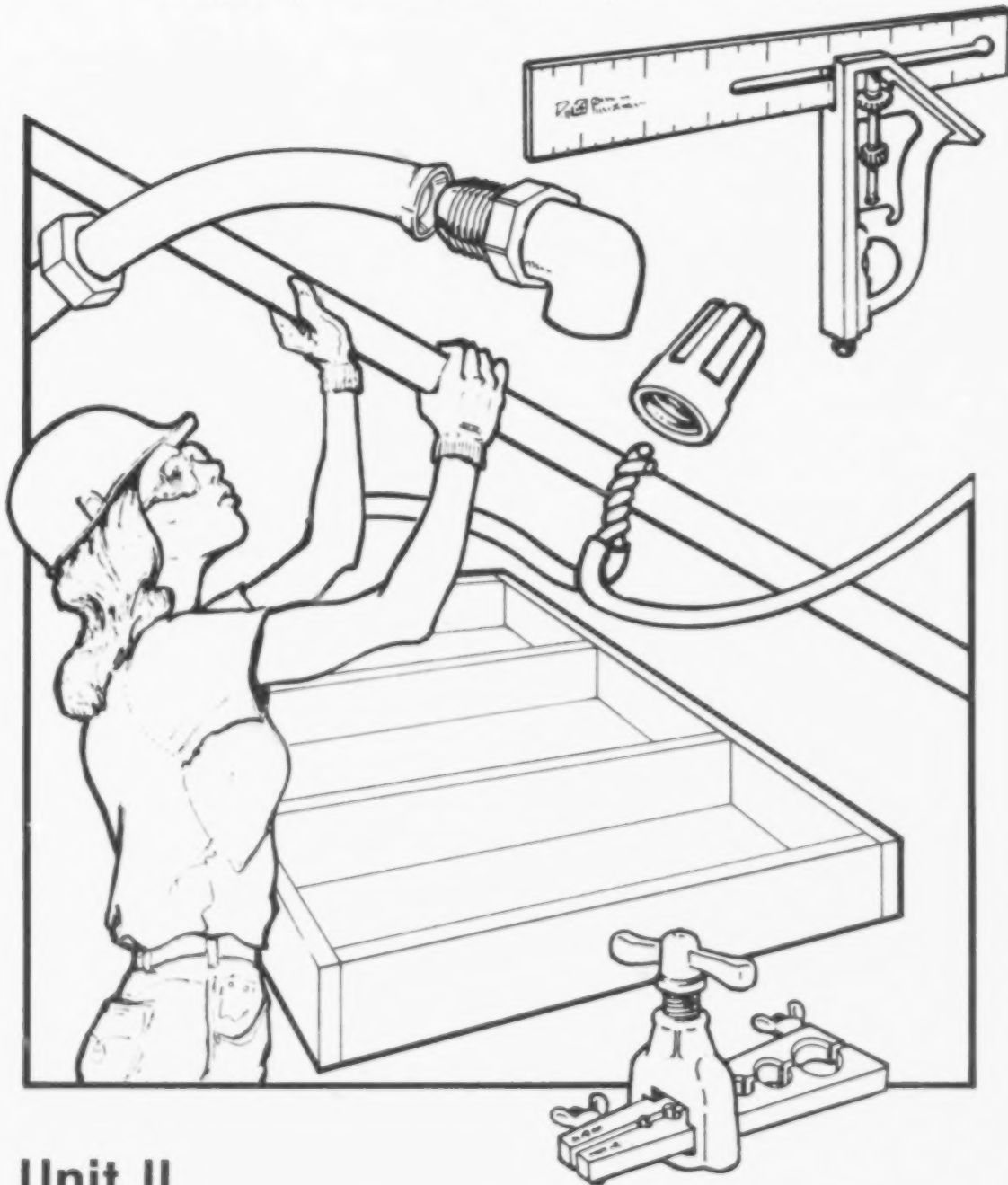
Jobs in Building Trades	Yes	No	Comments
1. Identified jobs in carpentry trades			
2. Identified jobs in plumbing trades			
3. Identified jobs in electrical trades			
Characteristics of a Good Employee			
1. Identified characteristics of cooperation			
2. Identified characteristics of following directions			
3. Identified characteristics of honesty			
4. Identified characteristics of enthusiasm			
5. Identified characteristics of initiative			
6. Identified characteristics of dependability			
Good Relations with Co-workers			
1. Recognized how to be friendly			
2. Recognized how to cooperate			
3. Recognized how to respect co-workers			

Should Move On ☐
Repeat This Unit ☐

Student Signature/Date

Instructor Signature/Date

Building Trades
Carpentry • Electrical Wiring • Plumbing



Unit II

Safety Procedures

Building Trades
Safety Procedures

Safety Procedures

After studying this unit, you will be able to:

1. Identify general safety rules for working in the building trades.
2. Identify safety procedures for working with electricity.
3. Identify safety procedures for working with cutting tools and sharp objects.
4. List safety rules for protecting your eyes, lungs, and ears.

Check the Statement that Fits You Best

☐

I can do these tasks and want to go through the Performance Checklist.



SEE YOUR INSTRUCTOR

☐

I want to study the information in this unit before I do the Performance Checklist.



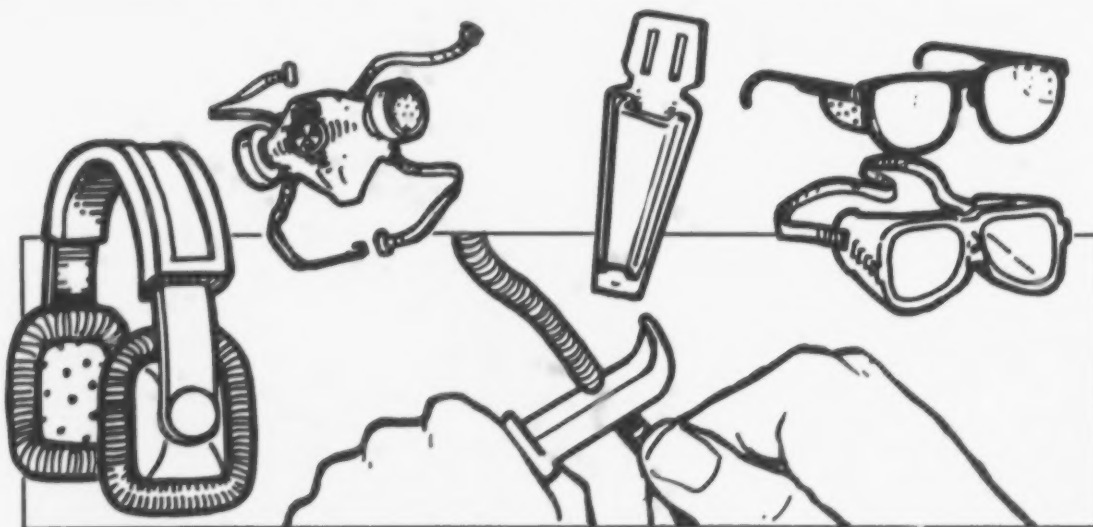
TURN PAGE AND BEGIN

Building Trades
Safety Procedures

Introduction

All construction textbooks and tool manuals have safety rules to follow. Study them carefully before you use the tool and perform the task. Following these rules will increase your safety.

To be a safe worker you must have a sixth sense or feeling that will caution you when something you are about to do is dangerous or wrong. A large part of the sixth sense is being alert, looking ahead at the consequences of your actions, and knowing the safety rules.



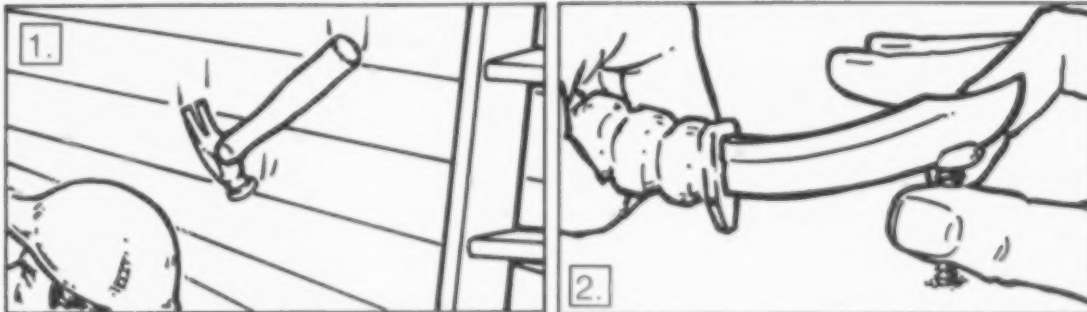
In this unit, you will learn about safety procedures to follow when working in the building trades.

TURN TO NEXT PAGE

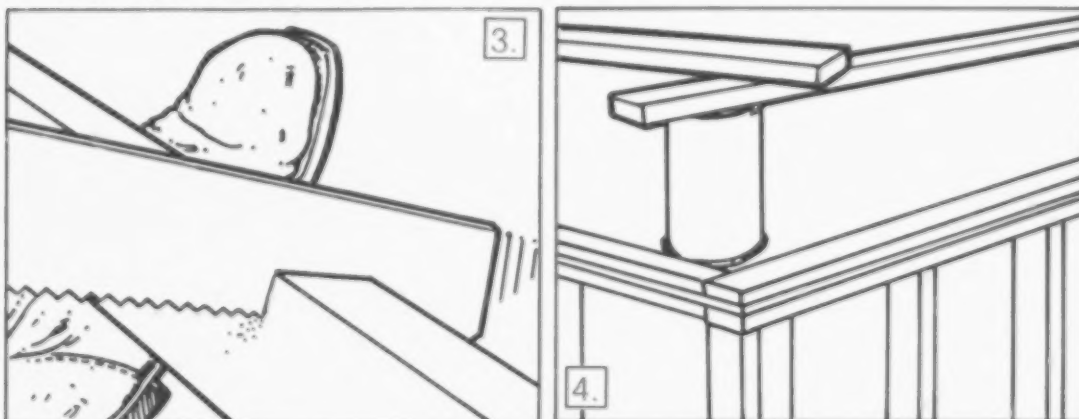
Building Trades
Safety Procedures

A. General Safety Rules for Working in the Building Trades

1. Never work directly above or below someone without extreme caution.



2. Only use a tool for what it was intended. (A knife is not a screwdriver.)
3. Never put any part of your body in a dangerous situation where it could get cut, pinched, scraped, shocked or otherwise hurt.



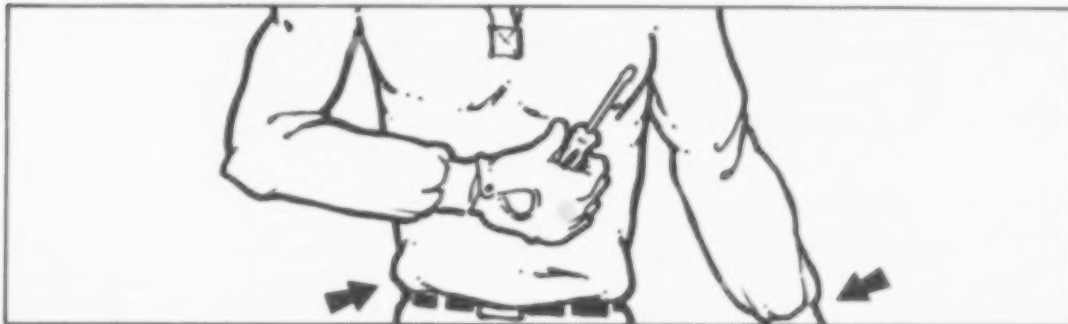
4. Never take risks - use appropriate safety backups as you work.
5. Always stay awake and alert to potential safety problems as you work.



6. If someone is being unsafe, don't work near them. If their behavior persists, report them to your supervisor.



7. Be aware of possible hazards of the job you are going to do and dress appropriately. Wear clothing that will not restrict your movement but be sure that it is not so loose or sloppy that it will get caught in the equipment.



8. If steel-toed shoes will be needed to protect your toes or if work shoes are needed to prevent slipping, be sure to wear them.
9. Always have gloves with you on the job.

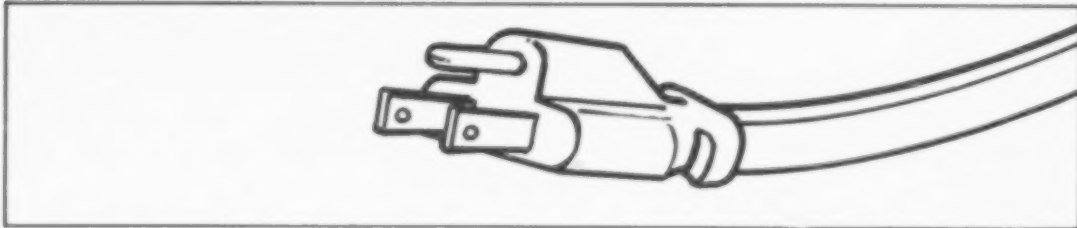


10. Listen to experienced workers. Experience is a great teacher.

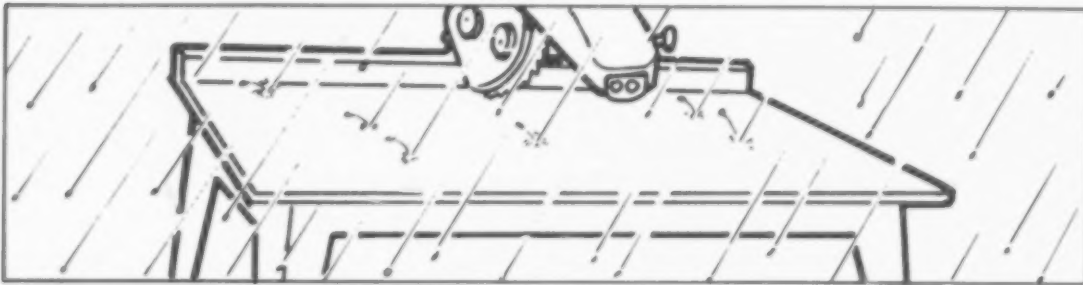
Building Trades
Safety Procedures

B. Safety Procedures for Working with Electricity

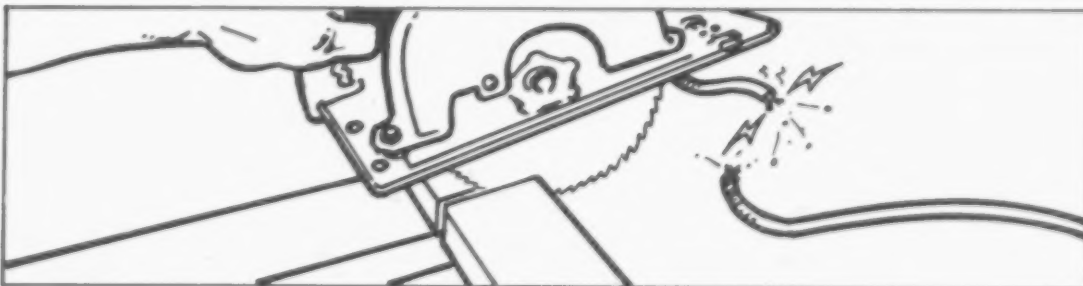
1. Be sure all tools are properly grounded before you use them.



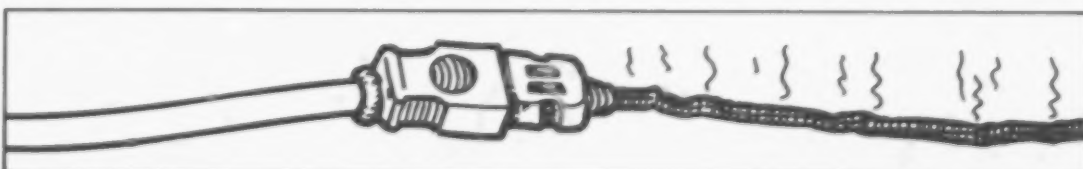
2. Never use electrical tools in rainy or wet conditions - a short or shock is a high risk condition.



3. Do not let your power cords or extension cords get in your way.



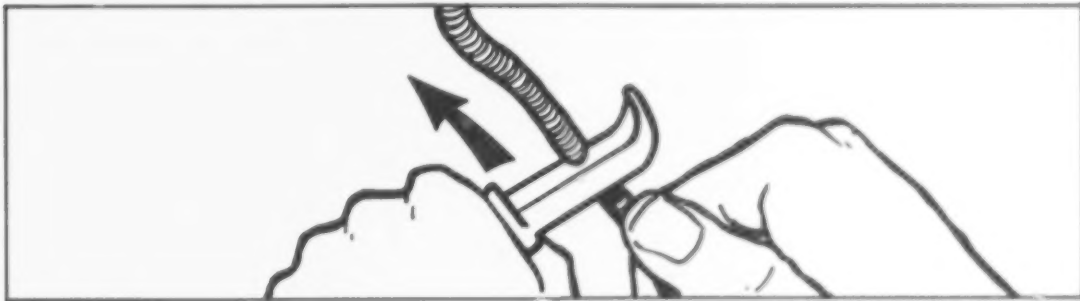
4. Be sure that extension cords have large enough wires to carry the proper current or the cord will overheat and the tool will burn up.



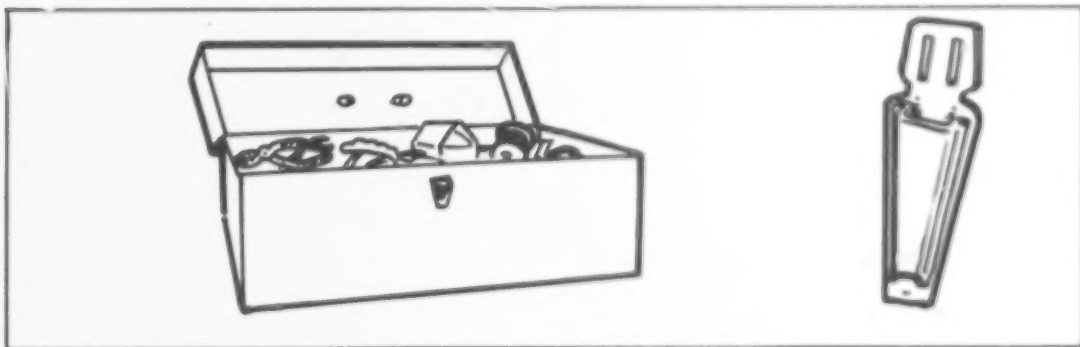
Building Trades
Safety Procedures

C. Safety Procedures for Working with Cutting Tools and Sharp Objects

1. Cut away from your body.



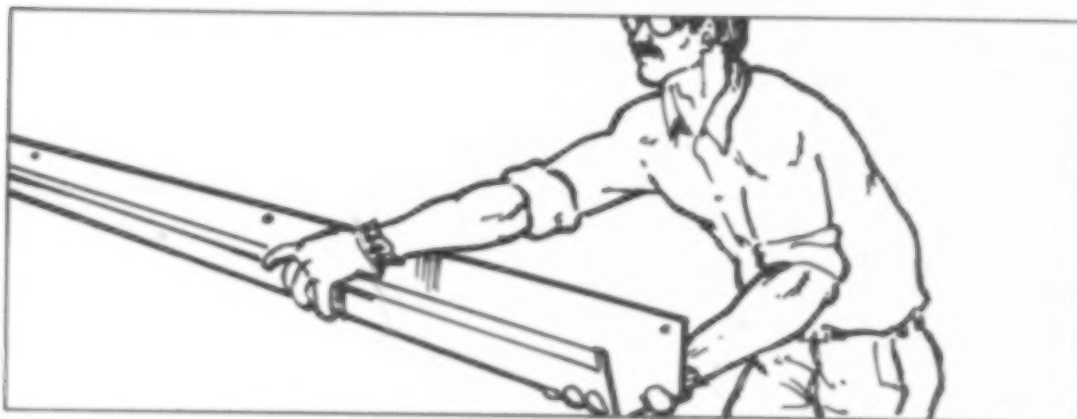
2. Always store cutting tools in your tool box, scabbard, or other safe place when not in use.



3. When you are cutting, concentrate on what you are doing and be aware of the people around you.



4. Be careful with sharp metal edges (siding, flashing, gutters, etc.). They can easily cut you. Wear gloves and other appropriate clothing.

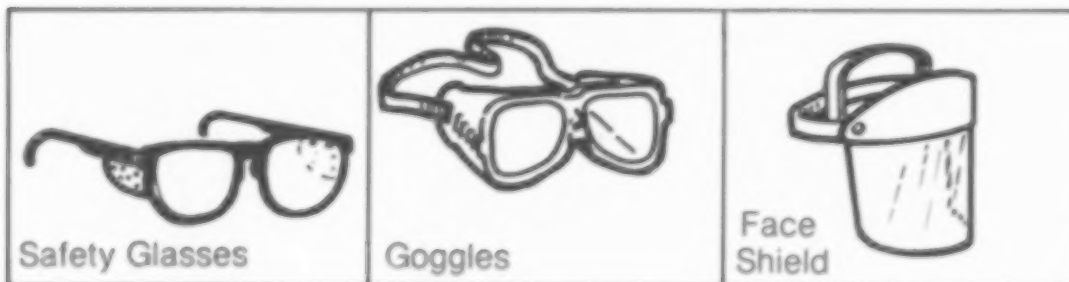


Building Trades
Safety Procedures

D. Safety Rules for Protecting your Eyes, Lungs, and Ears

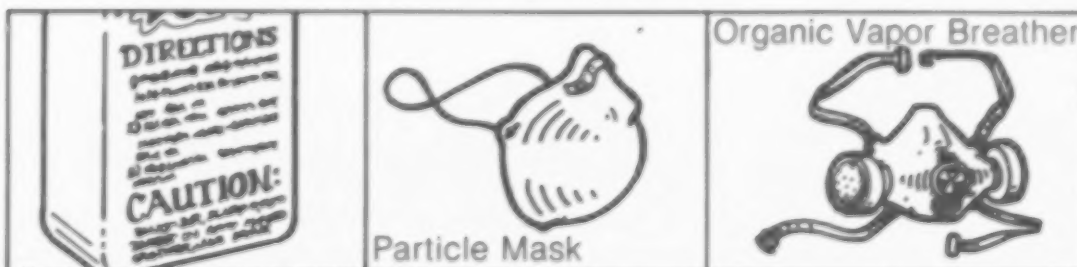
1. Guidelines for Protecting your Eyes

- Safety glasses are good protection for general use.
- In extreme cases of dust or fine particles (such as when working with fiberglass insulation), goggles are best.
- When there is a possibility of large objects hitting your face, use a face shield that covers your face, ears, and throat.



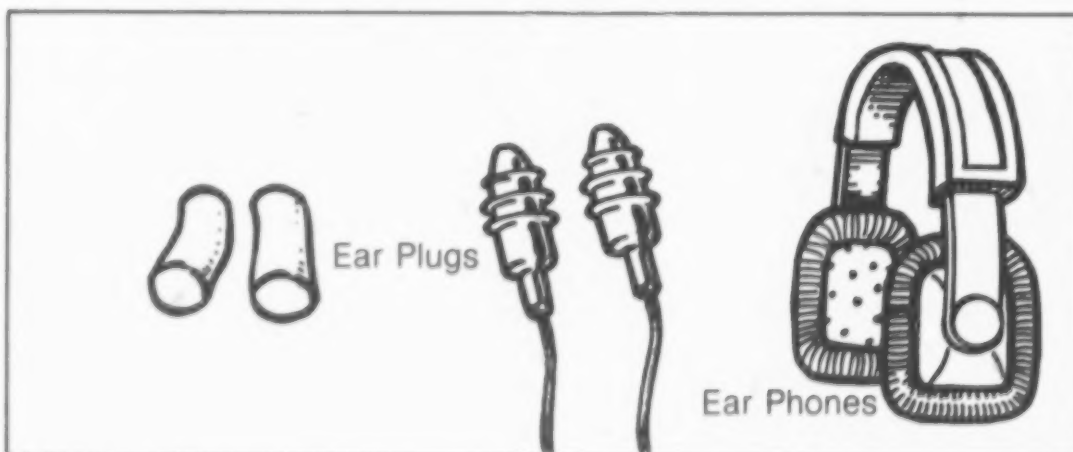
2. Guidelines for Protecting your Lungs

- Be aware of what you are using. Read the warnings and directions before working with chemicals, paint, insulation, etc. Wear appropriate safety equipment.
- Always wear a particle mask when working in dusty conditions.
- When using toxic chemicals like CCA wood treatment, thinners, or some paints, you need to use an organic vapor breather. (Organic vapor breathers have carbon filters to remove gases from the air and are the only devices that keep out the fumes.)



3. Guidelines for Protecting your Ears

- Over a period of time, exposure to high noise levels can damage your hearing. Working with proper safety habits now may save your hearing later.
- Ear protection is needed when working around loud noises to prevent hearing loss.
- Ear plugs work well if they can be left in all day and then cleaned or thrown away. (Frequent removal and replacement of ear plugs during work can cause ear infections if dust is pushed into the ear canal.
- Never wear someone else's ear plugs.
- Ear phones work well when ear protection is needed at various times during the day. However they are bulky and often cannot be found when you need them.



SEE YOUR INSTRUCTOR

Building Trades
Safety Procedures

Unit Review

Write the letter of the correct safety device in the blank beside each picture.

___ 1.



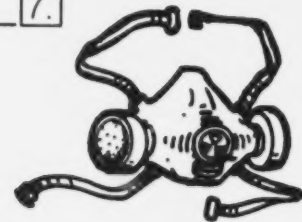
___ 2.



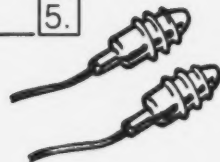
___ 3.



___ 7.



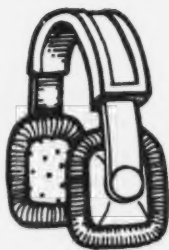
___ 5.



___ 6.



___ 4.



- A. Particle mask
- B. Organic Vapor Mask
- C. Safety Glasses
- D. Goggles

- E. Face Shield
- F. Ear Plugs
- G. Ear Phones

Write the letter of the correct answer on the blank at the end of each question. Use these answers:

- | | |
|--------------------|-----------------|
| A. ear infections | B. shocks |
| C. loss of hearing | D. face shields |
| E. particle mask | F. overheating |

- ___ 8. What could happen if a person does not wear ear plugs while working around loud noises?
- ___ 9. What protection should be worn if there is a possibility of large pieces of wood chips hitting your face while sawing?
- ___ 10. What should be used to protect your lungs when working in dusty areas?
- ___ 11. What could happen if you use a power tool while you are standing in a wet area?
- ___ 12. What will happen if the wires in an extension cord are not heavy enough to carry the proper current?
- ___ 13. What can result from wearing dusty ear plugs?

Circle at least five **safe** practices in the construction site pictured below.



Building Trades
Safety Procedures

Performance Checklist

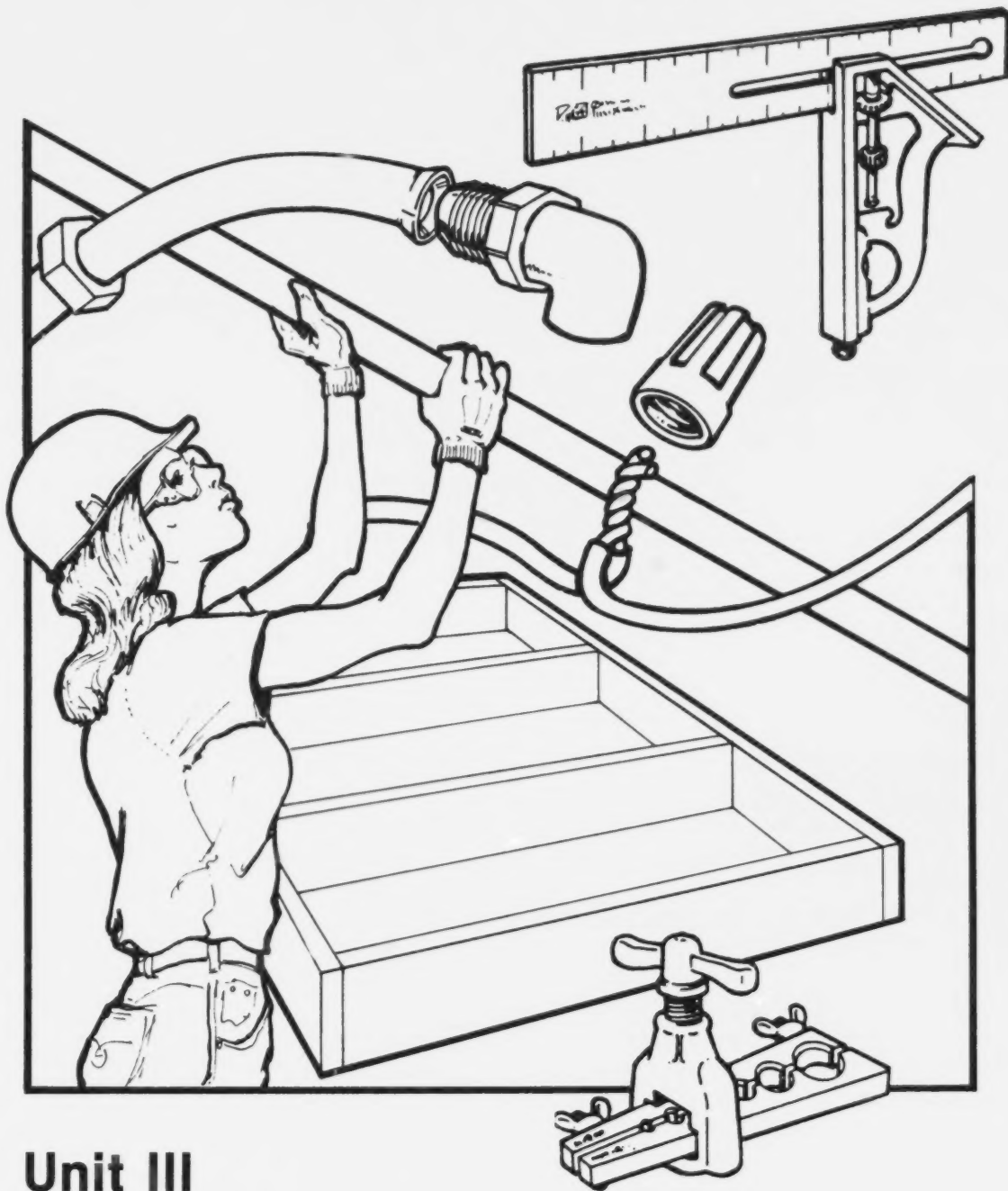
Student _____ has successfully performed the following steps of procedure.

General Building Trades Safety Rules	Yes	No	Comments
1. Worked carefully with other people			
2. Used tools correctly			
3. Did not take unnecessary risks			
4. Wore appropriate safety equipment and clothing			
5. Was always alert and listened to experienced advice			
Safety Rules in Electricity			
1. Was sure equipment was properly grounded			
2. Did not use equipment in wet or high risk conditions			
3. Was careful with extension cords			
Cutting Tools and Sharp Objects			
1. Used cutting tools properly			
2. Stored cutting tools/sharp objects properly			
3. Was aware of co-workers when cutting			
4. Wore proper safety equipment			
Eye, Ear, and Lung Protection			
1. Knew when to wear safety glasses, goggles, or face shield			
2. Knew what type of breathing mask to wear			
3. Properly used ear protection when working			

Should Move On ☐
Repeat This Unit ☐

Student Signature/Date

Instructor Signature/Date



Unit III

Identifying Carpentry Tools

Building Trades - Carpentry

Identifying Carpentry Tools

Identifying Carpentry Tools

After studying this unit, you will be able to:

1. Identify hand tools and their safe uses.
2. Identify power tools and their safe uses.

Check the Statement that Fits You Best.

☐

I can do these tasks and want to go through the Performance Checklist.



SEE YOUR INSTRUCTOR

☐

I want to study the information in this unit before I do the Performance Checklist.



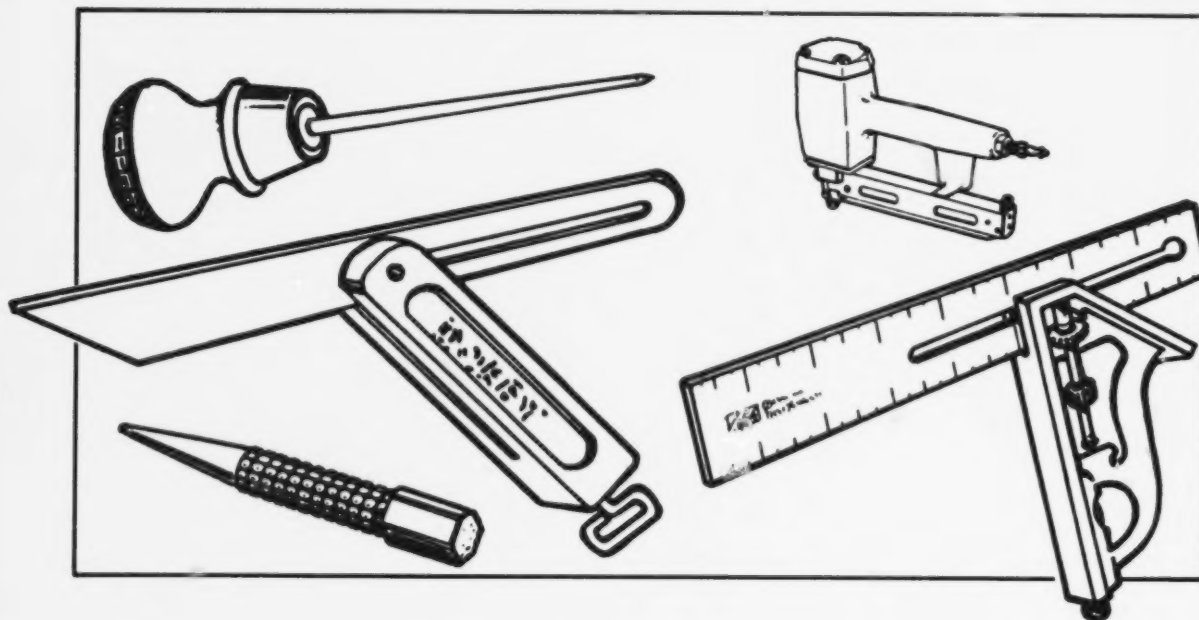
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Building Trades - Carpentry

Identifying Carpentry Tools

Introduction

An important part of the carpentry trade is using the correct tools for certain jobs. If the correct tool is not used, the work becomes more difficult, and more dangerous, to do.



This unit looks at hand tools and power tools and describes how to use these tools safely. Once you have learned to identify and use tools safely, you will make carpentry work much easier and safer.

TURN TO NEXT PAGE

Building Trades - Carpentry

Identifying Carpentry Tools

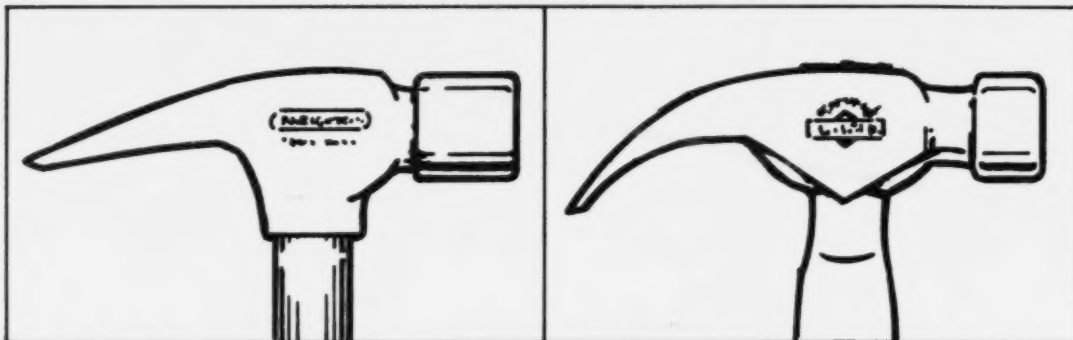
A. Terms and Definitions

1. Claw - the part on the back side of a hammer that looks like animal claws and are used for prying or pulling nails
2. Grain - the direction, size, arrangement, appearance, or quality of the fibers in the wood
3. Layout - the measuring and marking of stock, that has to be done before it can be cut, fastened, or assembled
4. Set the Nail - the act of driving a nail head below the surface of the stock with a hammer and a nailset
5. Snap a Line - marking the stock with a chalk line
6. Stock - the material you are using
7. Straightedge - some instrument or tool you can use to draw a straight line

Building Trades - Carpentry
Identifying Carpentry Tools

B. Identifying Carpentry Hand Tools

1. Hammers come with various types of handles, for example, wood, metal, and fiberglass. Hammer claws, which are used for pulling nails, come in two basic types, curved and straight claw.



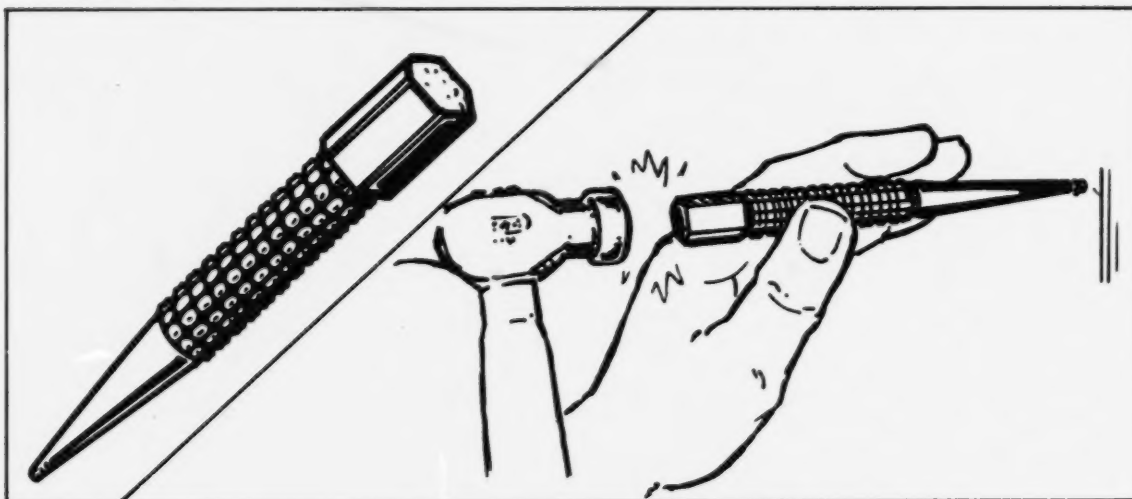
Hammers also come with different weight heads. The heavier (24 to 28 oz.) framing head is used for rough or frame work. The medium (16 to 20 oz.) head is used for all purpose work. The lightweight (13 oz.) head is used for finish or trim work.



CAUTION!

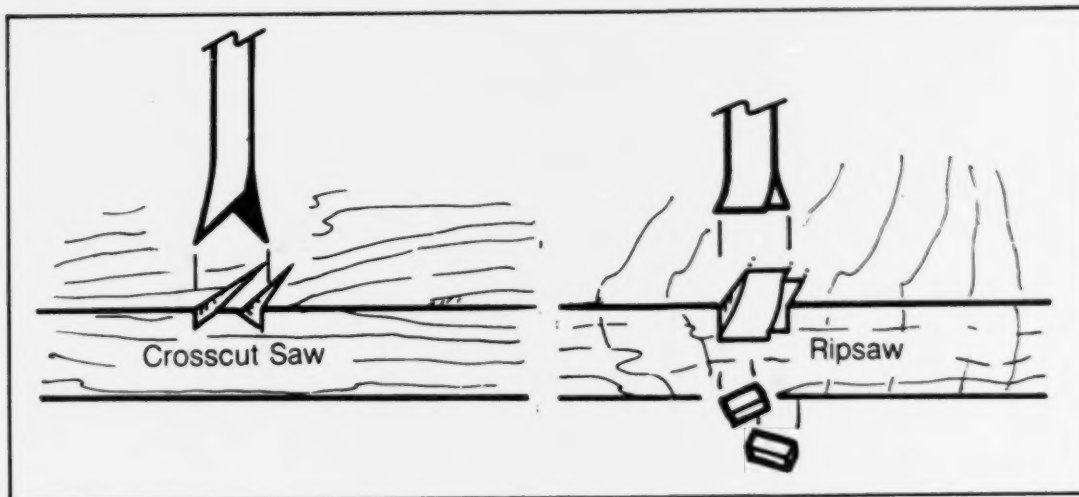
Always check that the hammer head is tight on the handle before using the hammer.

2. Nailsets come in several sizes and are used with a hammer to drive the heads of finish nails just below the surface of the board so they can be hidden with wood filler or putty.



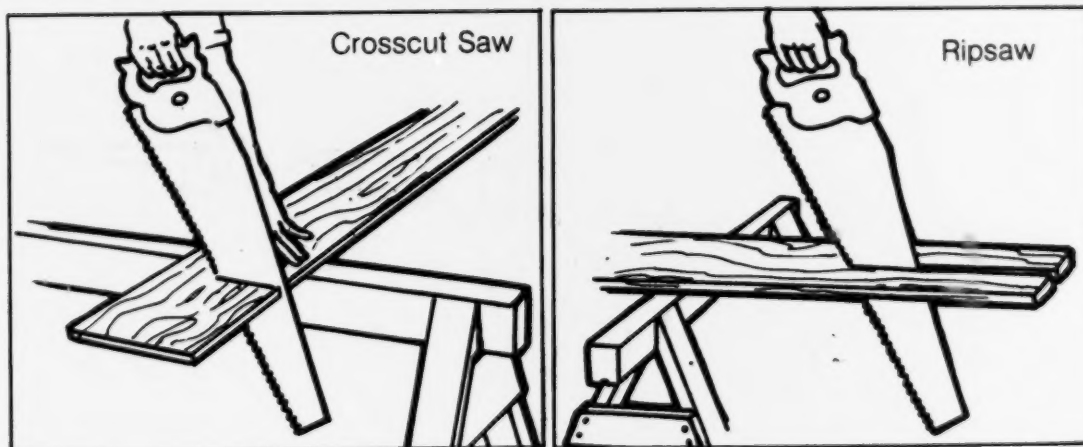
3. Handsaws are still used often in the building trades where power tools are ineffective.

Two of the most commonly used saws are the crosscut saw and the rip saw.



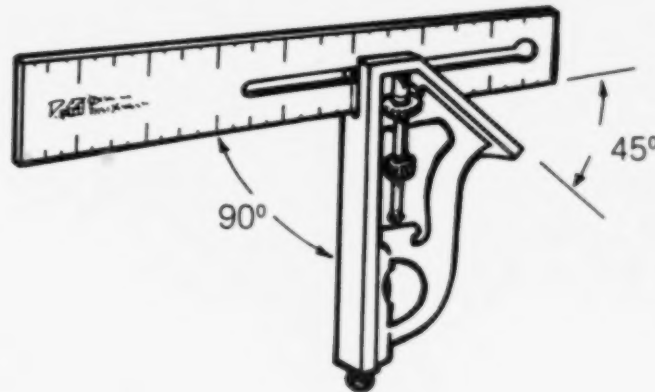
The crosscut saw is used to cut across the grain of the lumber. The teeth of the crosscut saw are beveled to a point. These sharp points of the teeth allow you to cut across the board without tearing the wood fibers and causing a rough edge.

The rip saw is used to cut with the grain. The teeth of the rip saw are shaped like a chisel and remove the wood fibers in much the same way.

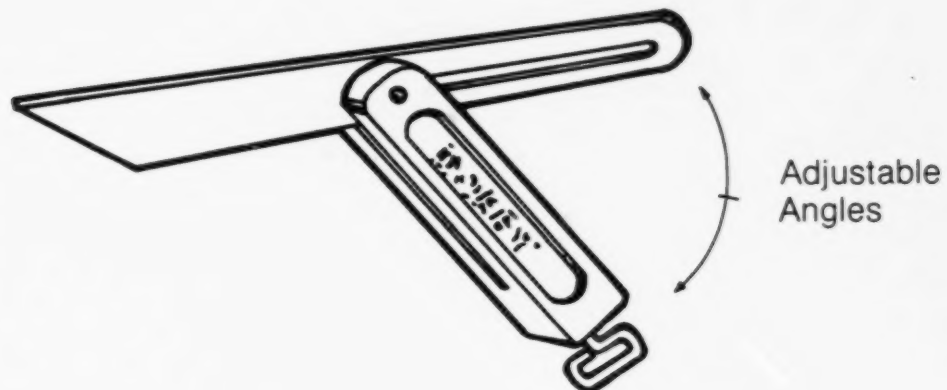


Layout tools are used to prepare and mark the stock according to the plans, and then to check how accurately the machine processes (sawing, drilling, nailing, etc.) were performed.

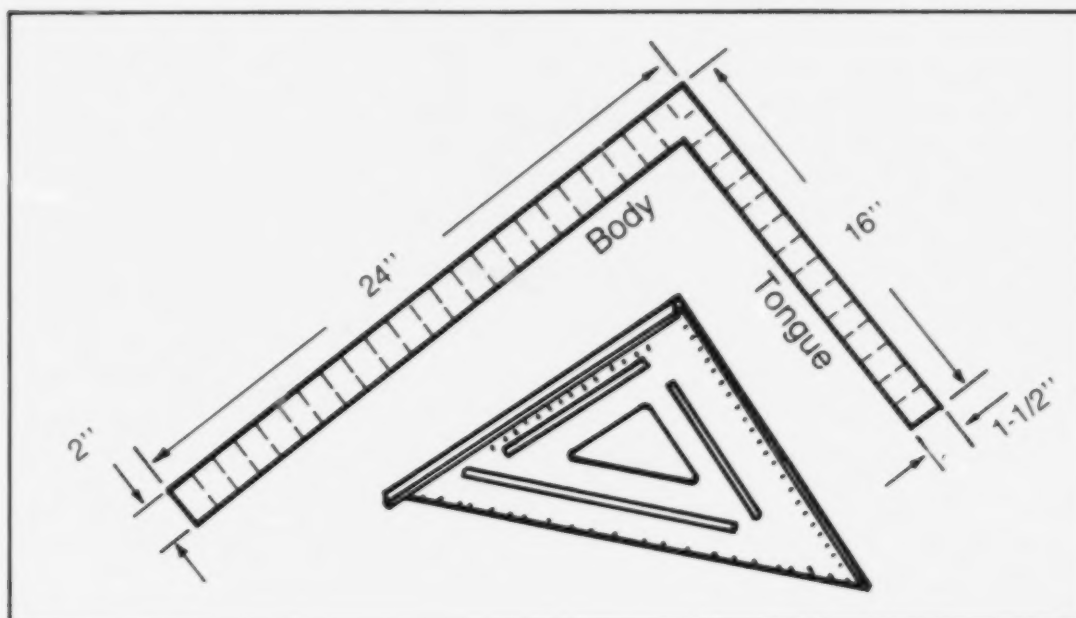
4. The combination square is usually carried in your tool pouch. It contains a 45° angle and a 90° angle. The body can be moved and locked along the blade so you can measure in many different situations. The combination square is for layout work and to check for squareness.



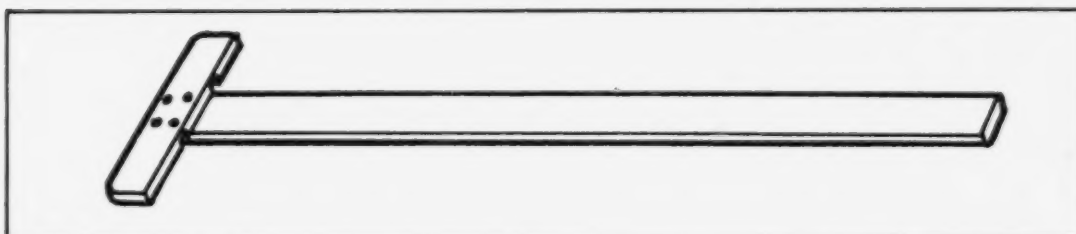
5. The sliding T-bevel is used in a manner similar to the combination square, except that the blade is adjustable and may be set out at any desired position. It is used to transfer or check angles.



6. The framing square is used for layout of rafters when framing a roof or checking large stock for square. The tongue of the framing square is $1\frac{1}{2}$ " wide (the width of a stud or rafter) and 16" long (Center to Center measurement of studs). The body is 2" wide and 24" long (the other Center to Center measurement used in walls or roofs). The framing square forms a right angle (90°).
7. The speed square is often carried in your tool pouch. It has a 45° angle, a 90° angle, and one side with a raised edge. The speed square is used for layout work.

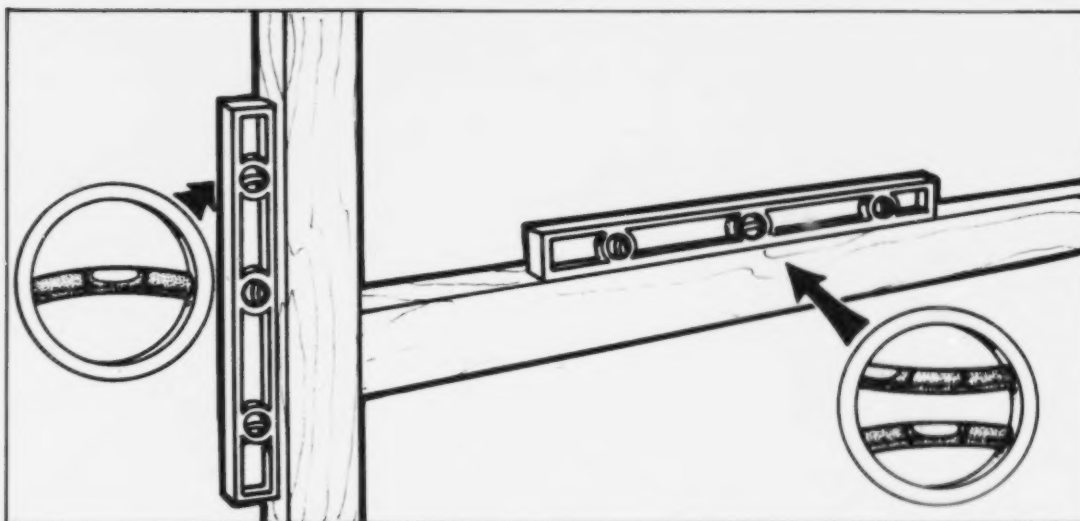


8. The sheetrock square is a large T-square used to layout and cut sheetrock (gypsum board). This tool is not highly accurate but it does, however, make a good straightedge for any large layout work.



9. Levels are used to see whether a surface is level or plumb.

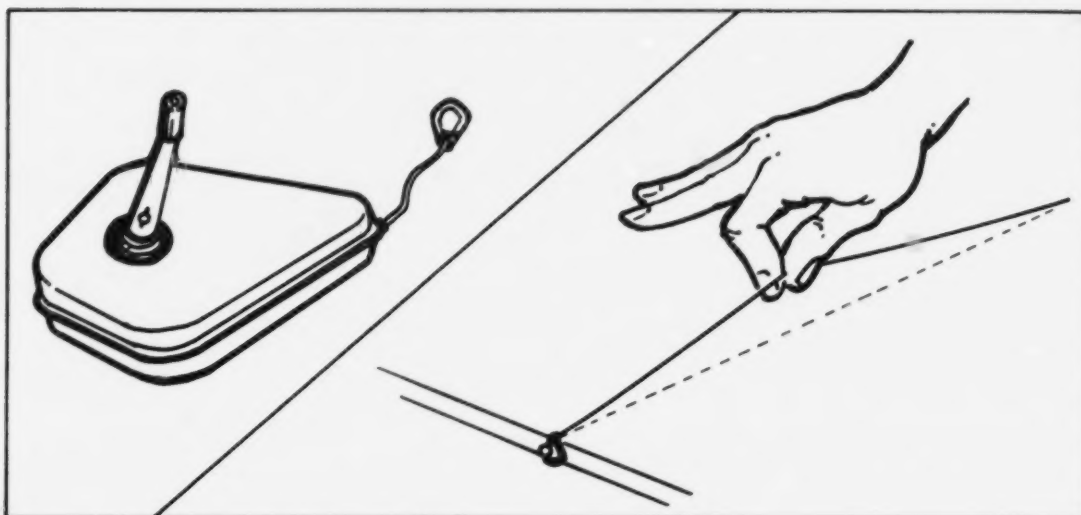
Levels are easy to read. A bubble of air is enclosed in a slightly curved glass tube filled with colored liquid. The tube has two lines marked on it. You get the correct reading when the bubble is centered between the two lines.



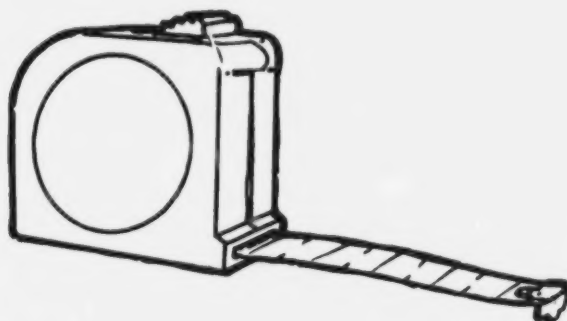
Framing levels are usually made from wood or metal and can be vary from 6 inches to 8 feet in length.

10. A chalk line is rolled up in a chalk box that holds colored powdered chalk which coats the line.

When this line is rolled out of the box and held tightly between two points, the line can be lifted about two inches off the surface and snapped against the surface to leave a straight chalk mark.



11. The tape measure has generally replaced the folding rule because it can take longer measurements more easily and accurately. They come in a variety of lengths and widths of the tape. The lengths are 6 ft., 8 ft., 10 ft., 12 ft., 25 ft., 50 ft., and 100 ft. The widths are 1/2", 5/8", 3/4", and 1". A tape measure is a long band of steel on a reel that is retractable. It is used for laying out and checking measurements. Since all phases of carpentry involve measuring and layout work, it is essential that a carpenter be able to read a tape quickly and accurately.



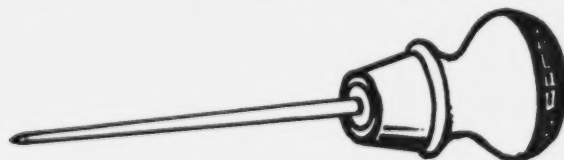
12. The utility knife is a razor sharp blade that retracts into a handle. It has many uses. One of which is cutting sheetrock.



CAUTION!

When using the utility knife, make sure that no part of your body is in line with the path of the blade.

13. Awls or scratch awls are marking tools. They are usually used to accurately mark points to be nailed or screwed.



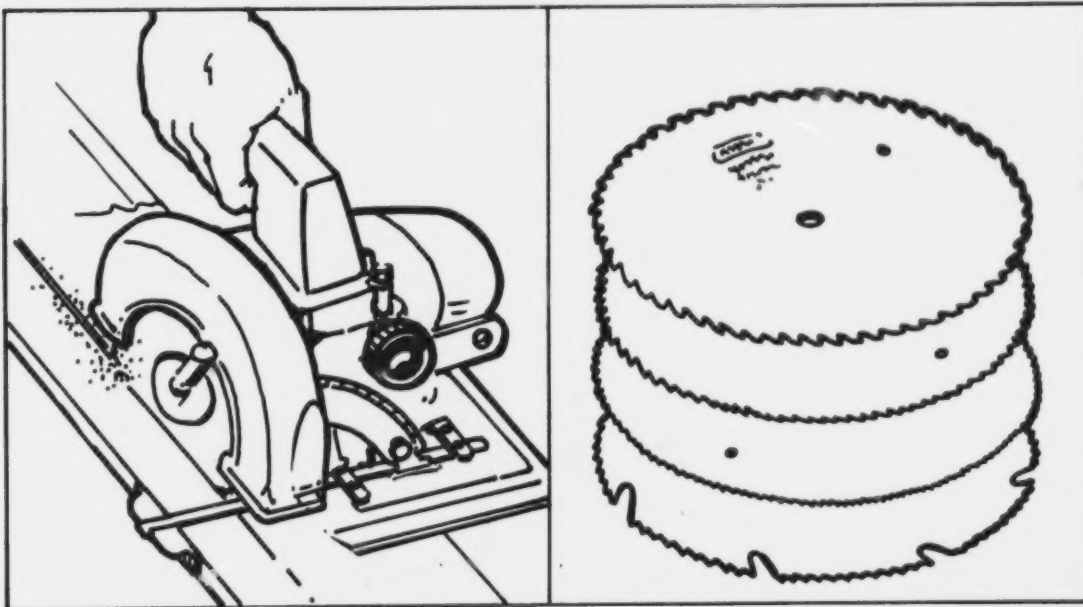
Building Trades - Carpentry

Identifying Carpentry Tools

C. Identifying Carpentry Power Tools

1. A portable circular saw is a motorized saw blade with a switch and handle attached.

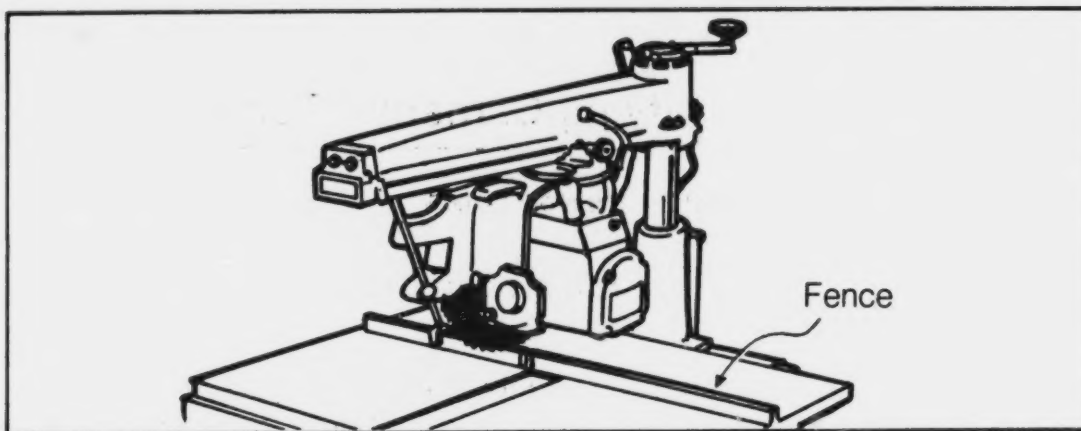
The circular saw can use a variety of blade types and sizes. These blades increase the saw's ability to cut different thicknesses and types of materials.



CAUTION!

Always use proper support when cutting with a circular saw. Be sure the piece being cut off can fall free so that the saw blade does not bind.

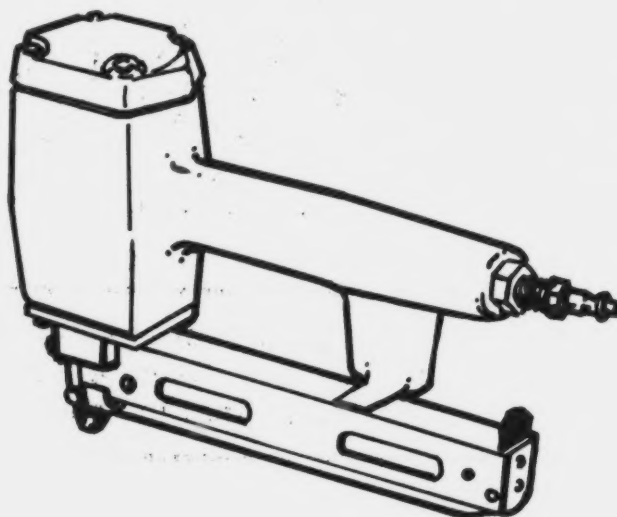
2. Radial arm saws are used on the job site as crosscut or cutoff saws. They are often easier and faster to use than portable circular saws. The stock is held flat on the saw table, against the saw fence and the motor and blade are pulled over the stock.



CAUTION!

Be sure the stock you are cutting is flat on the table and held tightly against the radial arm saw fence when using the saw.

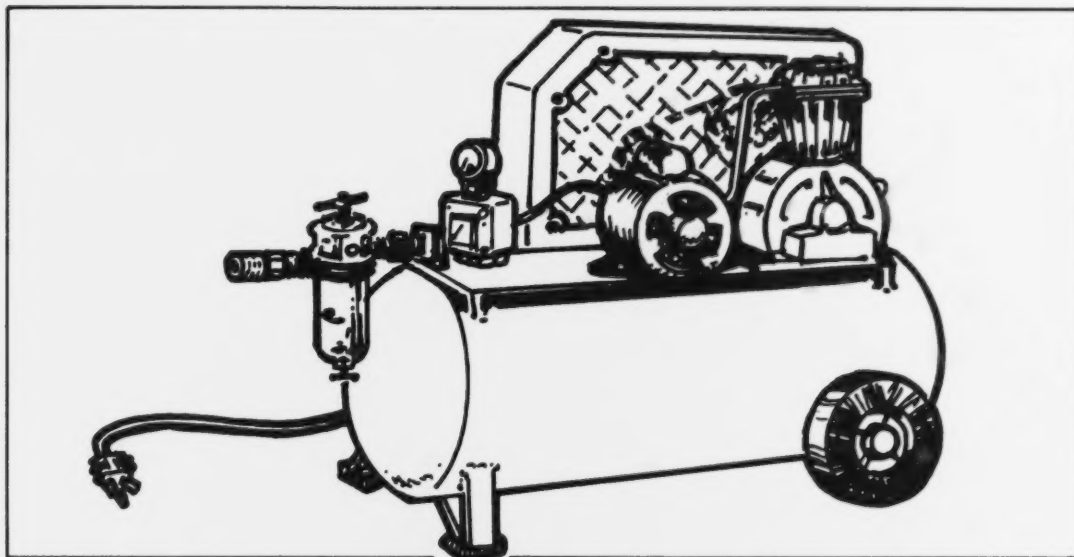
3. The air nailer drives nails using air pressure. The air stapler drives staples. These tools can shoot a variety of types and lengths of nails and staples.



CAUTION!

Always maintain a four-inch margin of safety when air nailing. A deflected nail can easily be driven into a person's body and must be removed by a doctor.

4. The air compressor can be run by a gas engine or electric motor. The compressor sucks air from the outside and forces it into a tank under pressure. Air hoses connect the compressor to the air guns.



SEE YOUR INSTRUCTOR

Building Trades - Carpentry
Identifying Carpentry Tools

Unit Review

Directions: Match the tools with their uses by writing the correct letter in each blank.

- | | |
|---------------------------|--|
| ___ 1. Hammer | A . Small tool used to check for squareness |
| ___ 2. Nailset | B . Nailing or pulling nails |
| ___ 3. Ripsaw | C . Cutting with the grain of lumber |
| ___ 4. Crosscut Saw | D . Cutting across the grain of lumber |
| ___ 5. Combination Square | E . Driving heads of finish nails below the surface of a board |
| <hr/> | |
| ___ 6. T-bevel | A . Cuts materials such as sheetrock |
| ___ 7. Sheetrock Square | B . Measures the length of boards |
| ___ 8. Level | C . Laying out and marking sheetrock |
| ___ 9. Tape Measure | D . Tells if surface is level or plumb |
| ___ 10. Utility Knife | E . Can be set in different positions to transfer or check angles |
| <hr/> | |
| ___ 11. Speed Square | A . Used for layout work and to cut help cut rafters with a circular saw |
| ___ 12. Awl | B . Marks points to be nailed or screwed |
| ___ 13. Radial Arm Saw | C . Portable power tool for cutting boards |
| ___ 14. Circular Saw | D . Used for cut-off and angle-cutting of boards |

Directions: Match each tool with its use by writing the correct letter in each blank.

___ 15. Air Compressor

___ 16. Air Nail Driver

___ 17. Air Stapler

___ 18. Chalk Line

___ 19. Framing Square

A . Marks a straight line between two points

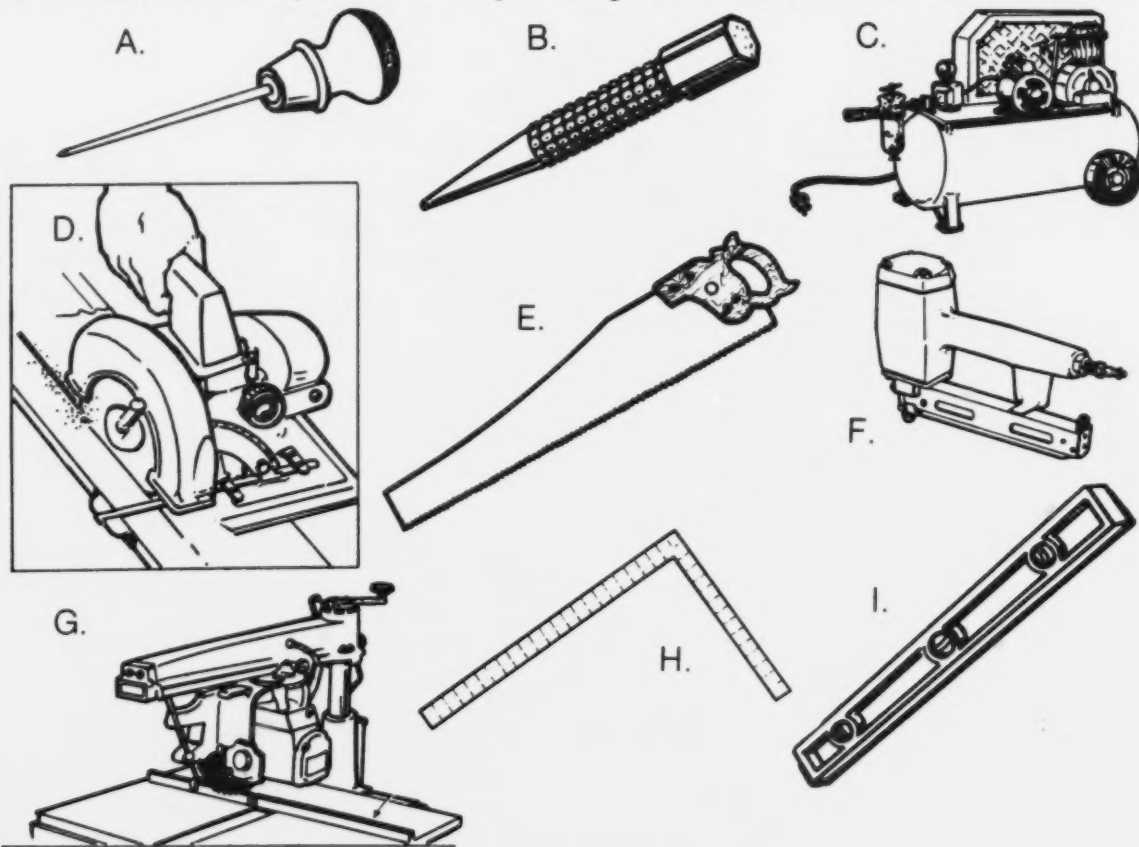
B . Drives staples with air pressure

C . Supplies pressurized air to tools

D . Used to lay out rafters or stairs

E . Drives nails with air pressure

Directions: Identify each tool by writing the correct letter in each blank.



___ 20. Framing Square

___ 21. Level

___ 22. Nailset

___ 23. Radial Arm Saw

___ 24. Circular Saw

___ 25. Ripsaw

___ 26. Awl

___ 27. Air Compressor

___ 28. Air Nailer

Building Trades - Carpentry
Identifying Carpentry Tools

Performance Checklist

Student _____ has successfully performed the following steps of procedure.

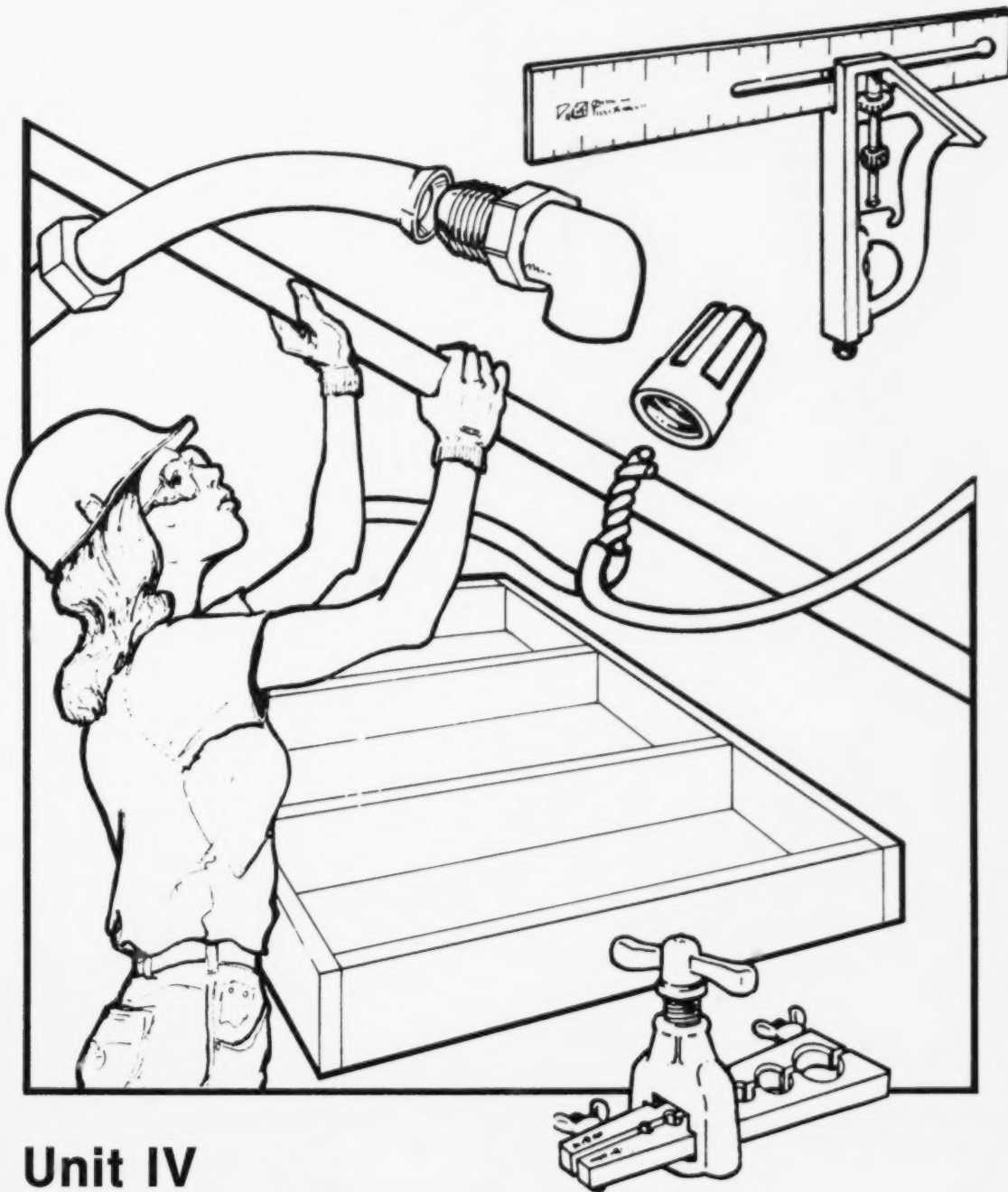
Identifying Hand Tools and their Safe Use	Yes	No	Comments
1. Identified hand tools			
2. Identified safe uses of hand tools			
Identifying Carpentry Hand Tools	Yes	No	Comments
1. Identified power saws, air nailer, and air compressor			
2. Identified rules for safe use of power tools			

Should Move On ☐

Repeat This Unit ☐

Student's Signature/Date

Instructor's Signature/Date



Unit IV

Using Building Materials

Instructional Materials Laboratory • University of Missouri-Columbia

Building Trades - Carpentry
Using Building Materials

Using Building Materials

After studying this unit, you will be able to:

1. Recognize lumber types, grades, and sizes.
2. Calculate board feet.
3. Calculate square feet.
4. Identify common fastening devices.
5. Identify common interior and exterior coverings.

Check the Statement that Fits You Best

☐

I can do these tasks and want to go through the Performance Checklist.



SEE YOUR INSTRUCTOR

☐

I want to study the information in this unit before I do the Performance Checklist.

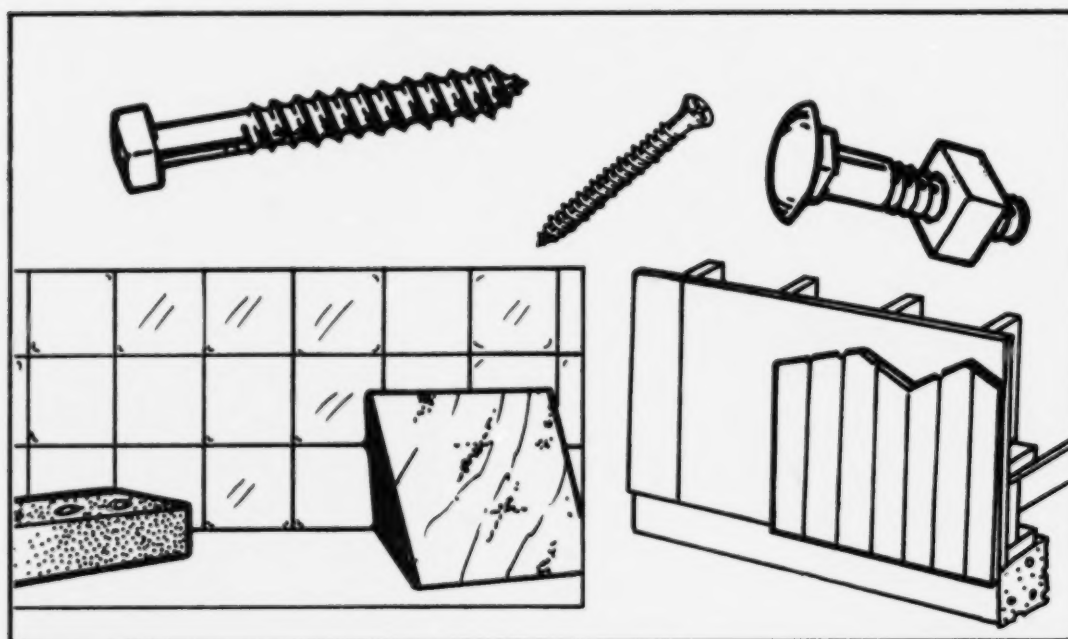


TURN PAGE AND BEGIN

Building Trades - Carpentry
Using Building Materials

Introduction

What type of lumber do you want to use when building? What grade of lumber? How many square feet will you need? How many board feet of floor joists will the building take? To get and keep a job in the building trades industry, you must be able to accurately answer these types of questions.



In this unit, you will learn about lumber sizes, types, and grades; how and when to calculate board feet and square feet; common fastening devices; and interior and exterior wall coverings. This information will give you some of the basic information you will need as a building trades worker.

TURN TO NEXT PAGE

Building Trades - Carpentry
Using Building Materials

A. Terms Used in Building Materials

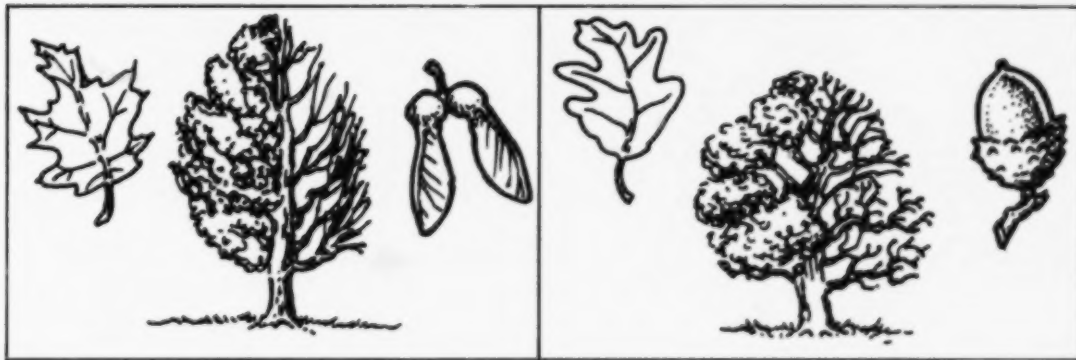
1. Nominal Size: an unfinished rough size of lumber before it is machined or milled
2. Crossbanding: alternating grain direction in ply layers of plywood
3. Framing: constructing walls, floors, and roof members of a structure
4. Board Foot: three dimensional amount of lumber; measured in cubic inches
5. Square Foot: area amount; length times width of a space
6. Countersunk: making a hole in a board surface so a screw head will not be above the surface
7. Flush: having the surface even or level with the surrounding surface
8. Studs: vertical members of wood or metal used as supports in walls and partitions
9. Joists: horizontal members of wood or metal used as floor and ceiling supports
10. Grout: A thin mortar (plaster) used to fill cracks in masonry work
11. Acoustic: Having to do with sound or controlling sound
12. Veneer: Thin covering or layer on framework of house or material
13. ' : Symbol for feet (ft.)
14. " : Symbol for inches (in.)

Building Trades - Carpentry
Using Building Materials

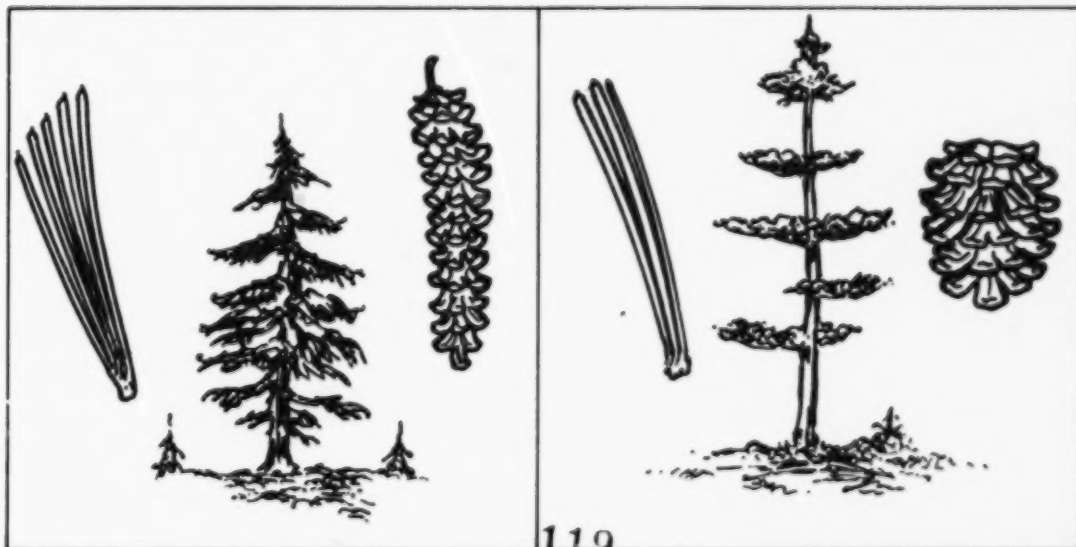
B. Recognizing Lumber Sizes, Grades, and Types

Lumber Types

Lumber is divided into two main groups: hardwoods and softwoods. Hardwoods have broad leaves (called deciduous) and lose their leaves each year. Hardwoods are used for furniture, cabinets, and floors.

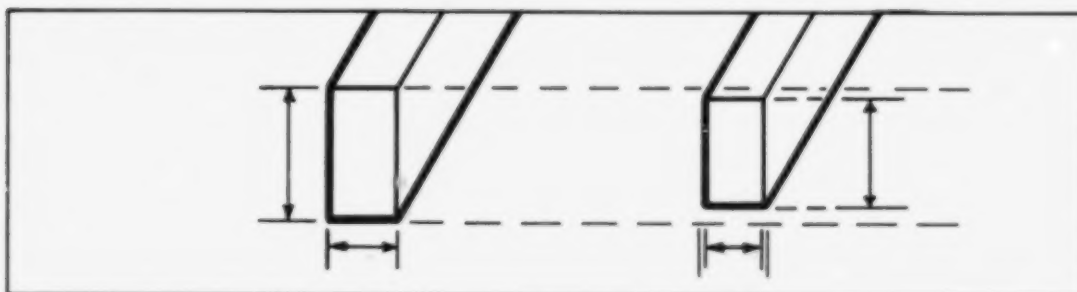


Softwoods are conifers or cone bearing trees, have needle-type leaves, and are often called evergreens. The common types of softwood lumber used in the construction industry are: pine, fir, hemlock, spruce, cedar, cypress, and redwood. Softwoods are used for framing and rough construction work.

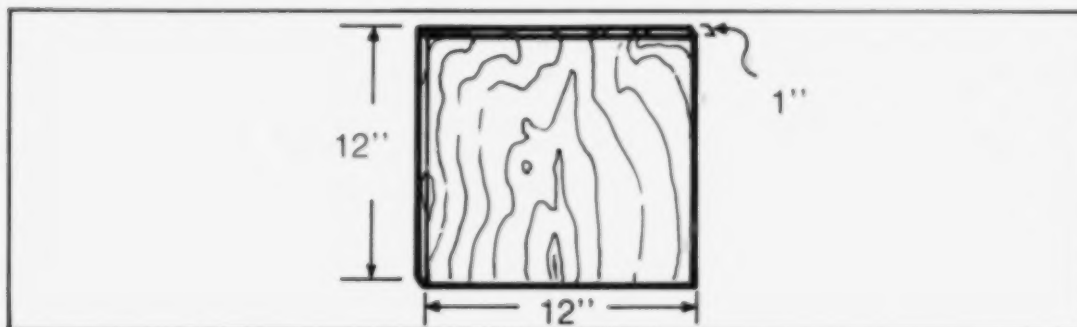


Lumber Sizes

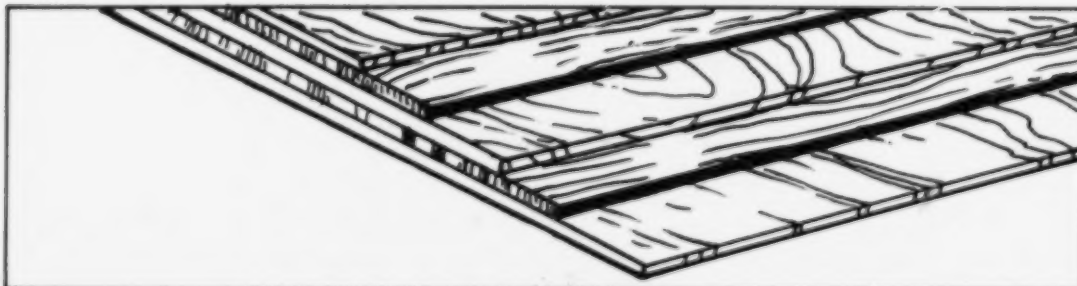
Lumber is cut at the sawmill to its nominal or rough sawn dimensions. The lumber is then milled to a uniform or finished dimension. A board's nominal size does not change even though its actual size does. This is why a board called a 2"x 4" is actually only 1½"x 3½" or a 2"x 6" is actually 1½"x 5½." The rough or nominal size is different from the milled or actual finished size.



Lumber is sold by the board foot. A board foot is 12"x 12"x 1."

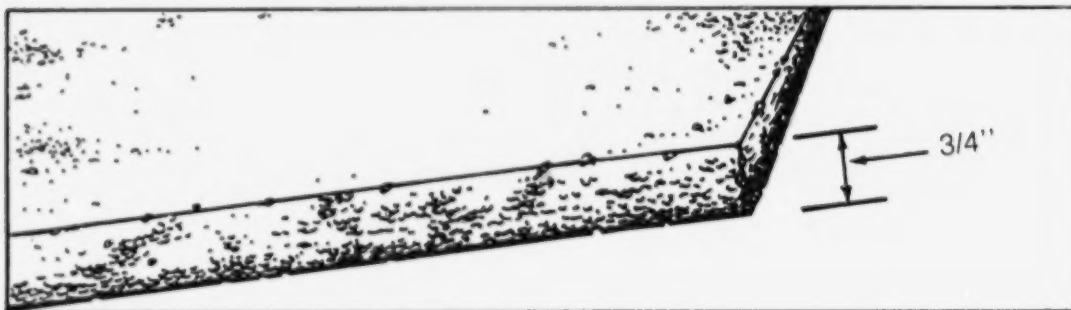


Plywood is made of thin layers (plys) of lumber glued (laminated) together to form panels or sheets. Plywood is laminated in odd numbers (3, 5, 7, etc.) of plies. Typical plywood construction is 5-ply. The grain direction of each ply is at 90° across the ply above and below it. This crossbanding makes the plywood stronger and more stable. The most common size of plywood is a 4 foot by 8 foot sheet. The most common thicknesses are from ¼" to ¾" thick.



Construction plywood is made from softwoods. Plywood made from hardwoods is used for furniture, cabinets, and wall panelling.

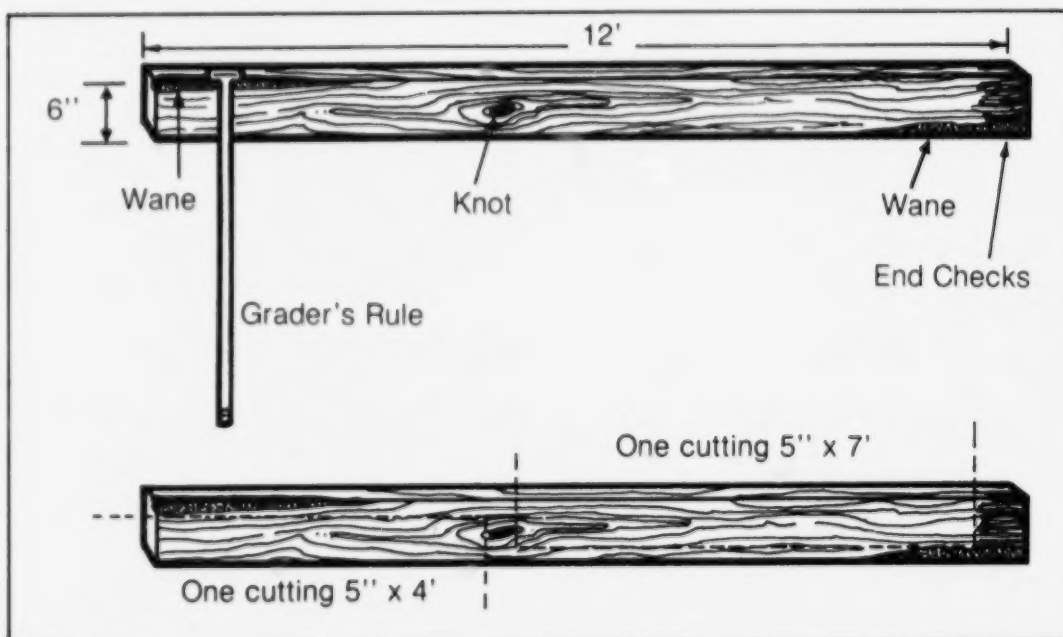
Particleboard is made of sawdust and glue squeezed together under high temperature and pressure. It is less expensive and not as strong as plywood but can be used for floor and roof covering.



Lumber Grades

Lumber grades are established by wood product associations made up of sawmill owners. Grading systems vary from association to association.

The better the grade, the more expensive the lumber is. For example, Number 2 (standard and better) lumber is a higher quality of lumber than Number 3 (utility) which is better than a Number 4 (economy).

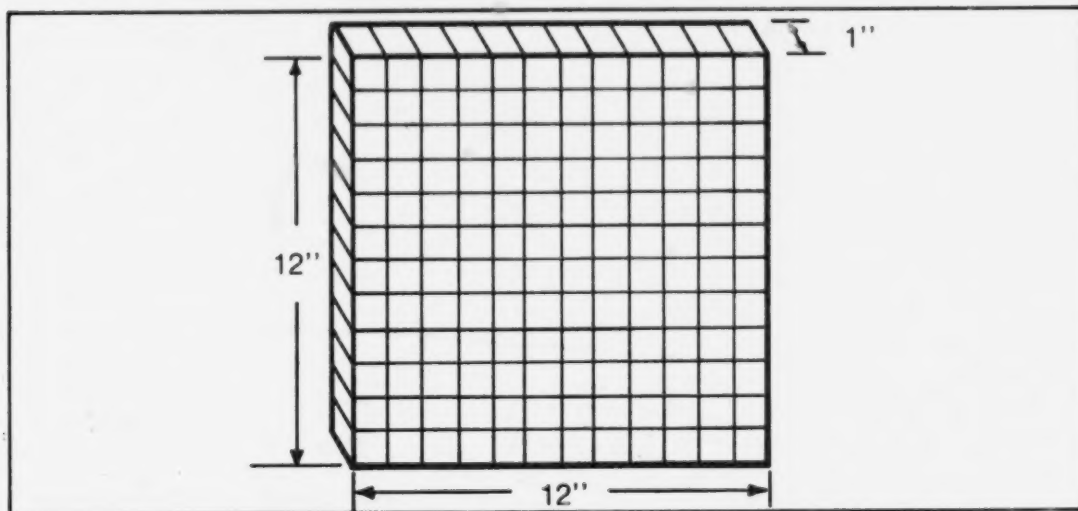


Building Trades-Carpentry
Using Building Materials

C. Calculating Building Materials

Board Feet

Lumber is priced by the board foot (12"x 12"x 1"). If one board foot of lumber was divided into 1"x 1"x 1" cubes, there would be 144 of these cubes.



That is why 144 cubic inches make one board foot. That is also why, when figuring board feet, the total number of cubic inches is divided by 144. The formula for calculating board feet is:

$$\frac{\text{Number of Pieces (Thickness''x Width''x Length'')}}{144}$$

Because 144 cubic inches make one board foot, any piece of wood that has 144 cubic inches is the same as one board foot.

$$\left. \begin{array}{l} 1'' \times 12'' \times 12'' \text{ equals } 144'' \\ 2'' \times 6'' \times 12'' \text{ equals } 144'' \\ 3'' \times 4'' \times 12'' \text{ equals } 144'' \\ 4'' \times 4'' \times 9'' \text{ equals } 144'' \end{array} \right\} = \text{All of These Are One Board Foot}$$

Here are the steps for figuring board feet:

Change all the feet measurements to inches by multiplying
number of feet x 12.

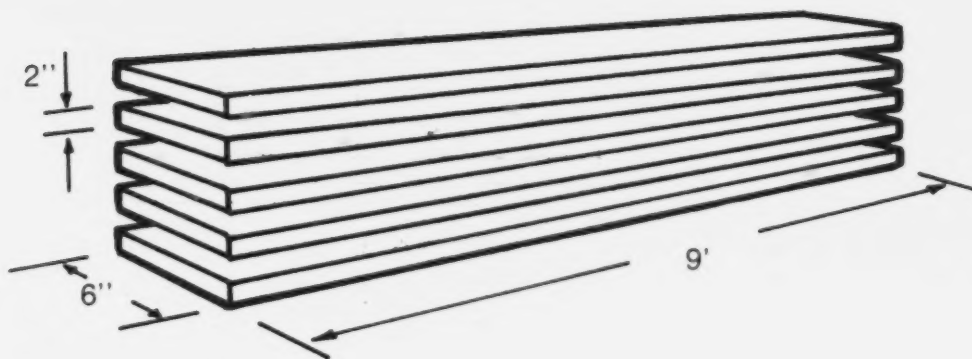
Put the numbers into this formula:

$$\frac{\text{Number of Pieces}(\text{Thickness''} \times \text{Width''} \times \text{Length''})}{144}$$

Multiply the number of pieces, the thickness, the width, and the length together. Divide by 144 because there are 144 cubic inches in one board foot.

Problem: Figure the total board feet of five pieces of lumber which are 2'' thick, 6'' wide, and 9 feet long.

$$\frac{(\text{Number of Pieces})(\text{Thickness''} \times \text{Width''} \times \text{Length''})}{144}$$



1. Change 9 feet into inches ($9' \times 12'' = 108''$)
2. Put all the numbers into the formula:
$$\frac{(\text{Number of Pieces})(\text{Thickness''} \times \text{Width''} \times \text{Length''})}{144}$$

$$\begin{array}{r} 144 \\ \text{or} \\ 5 (2 \times 6 \times 108) \\ \hline 144 \end{array}$$

3. Multiply 2×6 to get 12
4. Multiply 12×108 to get 1296
So now the formula reads:

$$\frac{5 (1296)}{144}$$

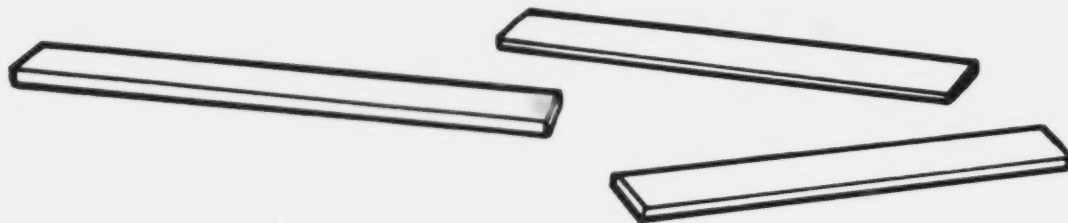
5. Multiply 5×1296 to get 6480 (the total cubic inches)
6. Divide 6480 by 144 to get 45 board feet

Dividing by 144 changes cubic inches into board feet because there are 144 cubic inches in one board foot.

More Practice

Now, try calculating board feet for the following pieces of lumber.

1. 3 pieces, 2" thick, 6" wide, 12 feet long
2. 9 pieces, 1" thick, 8" wide, 10 feet long
3. 10 pieces, 2" thick, 4" wide, 8 feet long



Here's what you should get for board feet:

$$1. \quad \frac{3 (2 \times 6 \times 144)}{144}$$

$$\frac{5184}{144}$$

36 board feet

$$2. \quad \frac{9 (1 \times 8 \times 120)}{144}$$

$$\frac{8640}{144}$$

or

60 board feet

$$3. \quad \frac{10 (2 \times 4 \times 96)}{144}$$

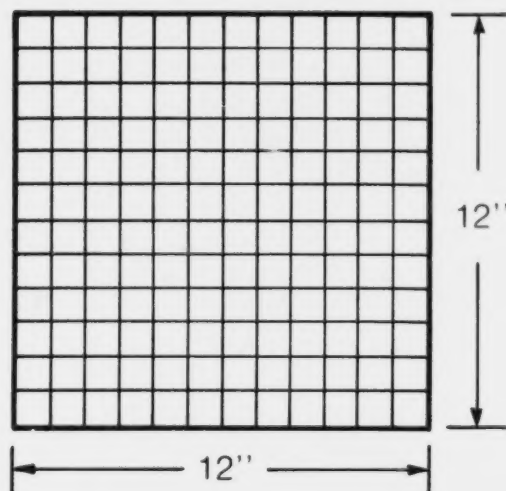
$$\frac{7680}{144}$$

53.33 board feet

Square Feet

In order to purchase material to cover an area in a structure, you must know how much material is needed to cover that area before you start. To figure this, you must use some mathematical skills. Look at how to calculate a square foot.

A 12'' square has only two dimensions 12''x 12''



Since sheetstock like plywood and particleboard usually comes in standard sheet sizes (4' x 8' or 32 square feet) that are less than one inch thick, they are calculated in square feet instead of board feet.

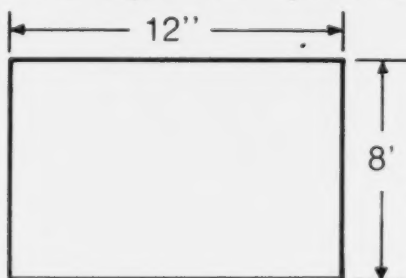
The formula for finding square feet is:

Length (ft.) x Width (ft.) equals Square Feet

Example:

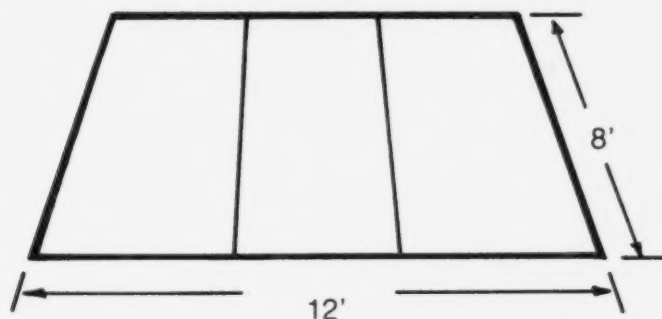
A room is 8 ft. by 12 ft. How many square feet are in this room?

8' x 12' equals 96 square feet



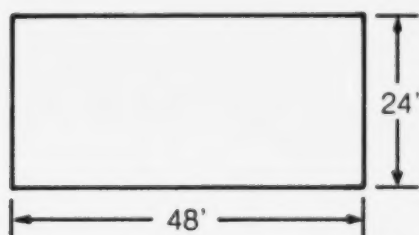
Since there are 32 square feet in one sheet of subfloor material (4'x 8' equals 32 sq. ft.), divide 32 into 96 to determine the number of subfloor sheets needed.

32 into 96 equals 3 (sheets of subfloor material)



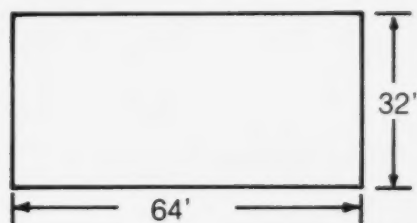
Work These Problems

1. How many square feet are in a house floor 24' by 48'? How many 4'x 8' sheets of plywood are needed to cover the floor?

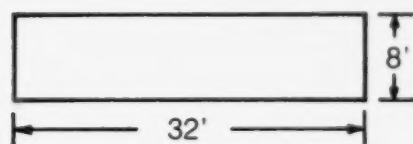


SHOW YOUR WORK

2. How many square feet would a house floor have if it measured 32' x 64'? How many sheets of 4'x 8' subfloor would be needed to cover it?



3. A wall 8' tall and 32' long needs to be covered with 4'x 8' wood paneling. How many sheets will it take?



Building Trades - Carpentry

Using Building Materials

E. Identify Common Fastening Devices

Nails

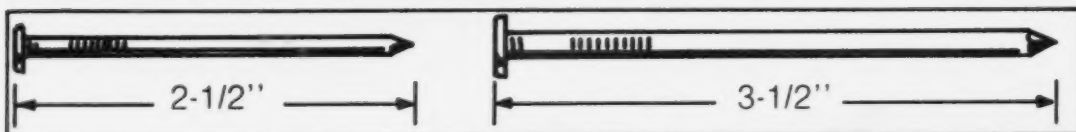
A carpenter works with many types of fastening devices. The most common are nails. Nails are made in many different types, sizes, and coatings. They are sold by the pound or in fifty pound boxes. Nails that are generally used in rough framing of floors and walls are called common nails. Some of the most familiar common nails are:

6^d (2" long) used for ½" material, an all-purpose nail

8^d (2½" long) used for ¾" material

10^d (3" long) used for 1" material

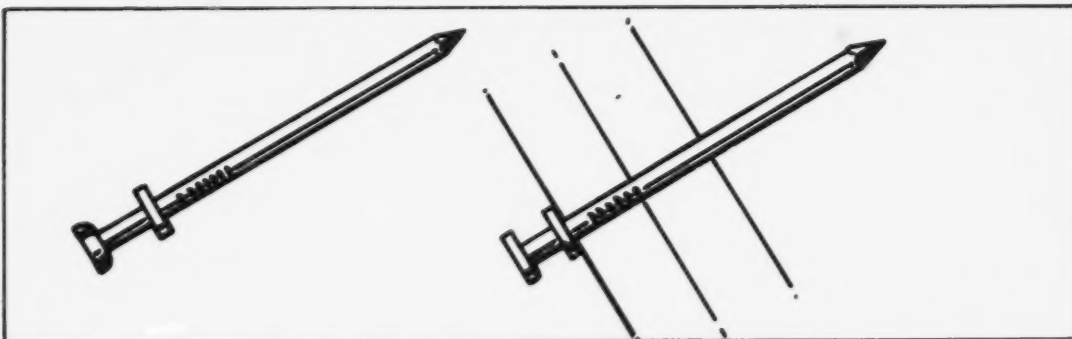
16^d (3½" long) used for 1½" material



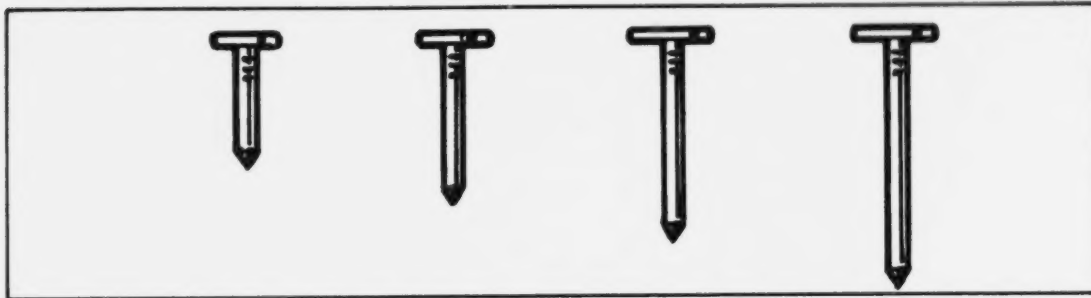
NOTE:

The "d" is pronounced as penny, for instance, an 8penny nail.

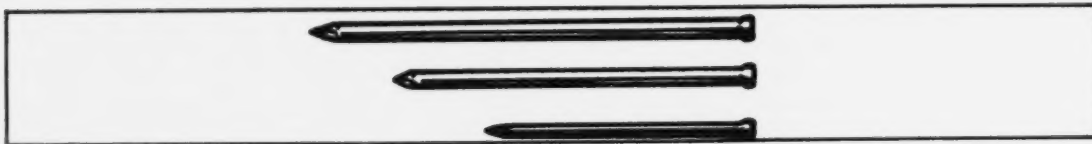
Double-headed nails (called scaffold nails) are used for work that will be taken apart, such as temporary braces, forms, and batterboards. When the nail is driven, the first head secures the work and the second head protrudes above the surface for easy removal later.



Roofing nails are coated with zinc to prevent rusting. They have large heads that hold the shingles better. They are sold in desired lengths such as: $\frac{3}{4}$, 1, $1\frac{1}{4}$, $1\frac{1}{2}$, $1\frac{3}{4}$, and 2" lengths.



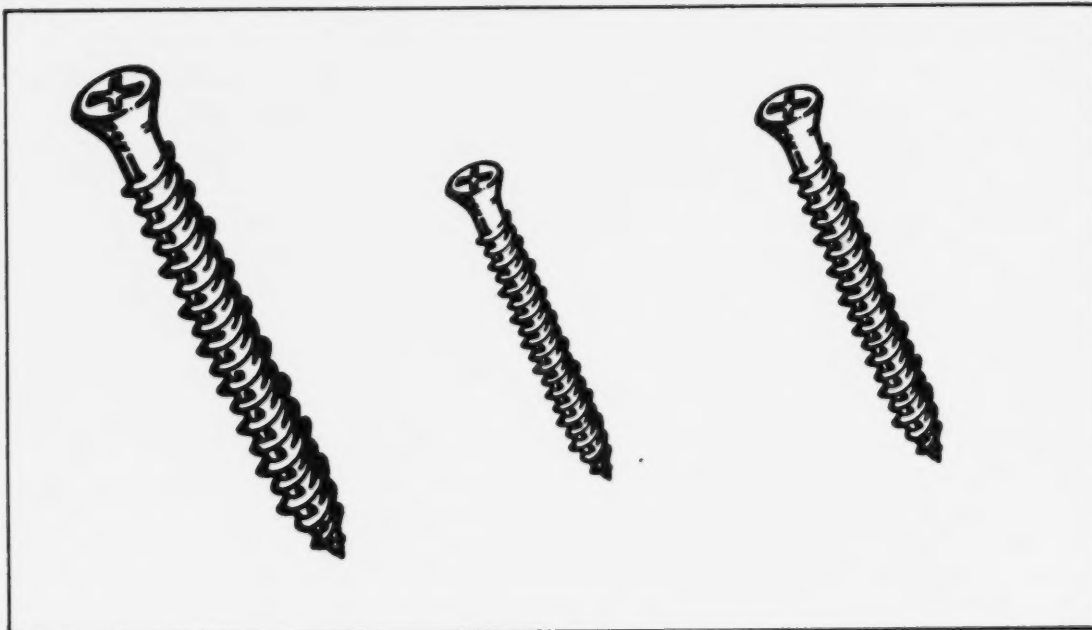
Finish nails have small heads. They are generally used for trim and are meant to be set below the surface of the material.



Screws

Screws are sold by the hundreds. They are measured with the numbers 3 through 16. The larger the number, the bigger the diameter. They are also sold by their length.

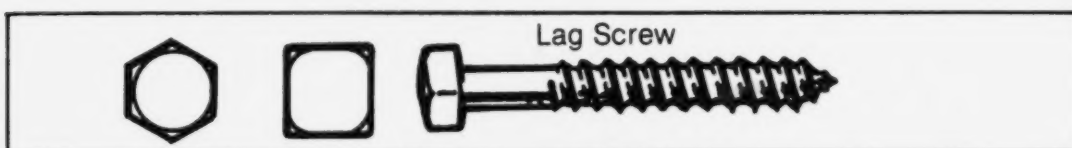
There are other types of screw which are usually used in industry.



Screws also have different shapes of heads. Round heads are used where the head will be seen. Flat heads are used and countersunk with the head flush with or below the surface. Oval heads are used where the head is seen but also countersunk. And panhead screws are used on sheet metal or soft wood.



Lag screws are generally larger and are put in with a wrench. They are used where a large amount of holding power is needed.



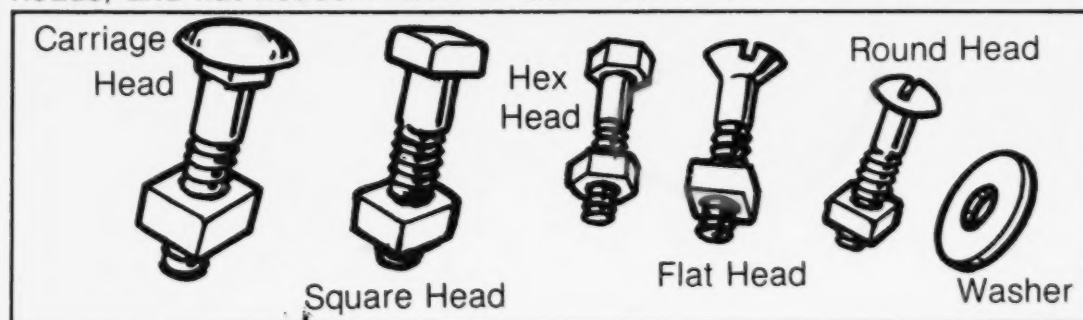
Most screws have either a single slot (standard) or a Phillips head. There are other types of screws though, usually used in industry.



Bolts

Bolts also come in various sizes, shapes and lengths. They are purchased in boxes of fifty or one hundred. Bolts are sold by the diameter and the pitch (number of threads per inch) of the thread. For instance, $\frac{1}{4}$ "-20 means $\frac{1}{4}$ " in diameter and 20 threads per inch.

Bolts have different types of heads such as square heads, round heads, and flat heads. A bolt is used with a nut and washer.



Building Trades - Carpentry

Using Building Materials

E. Identifying Common Interior and Exterior Coverings

Interior Coverings

Interior coverings are the coverings for walls, ceilings, and floors inside a structure. Each group has many different types of materials with hundreds or even thousands of styles within each type.

Floor Coverings

Floor coverings are picked for their cost, ease of installation and maintenance, durability, and looks. Wooden floors are still very popular in homes and come in three main types: hardwood, softwood, and sheet flooring.

Hardwood flooring is usually oak. It is tongue and grooved strip flooring that is nailed to the subfloor. Hardwood flooring comes in different widths and lengths.



A specialized type of hardwood flooring that comes in a "tile" form is called parquet ("par-kay") flooring. Parquet is several small pieces of hardwood laid out in a pattern.

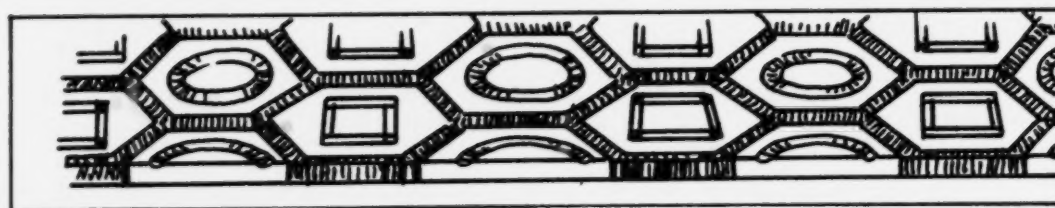


Softwood flooring is usually made of pine. It also is tongue-and-grooved strip flooring that comes in different lengths and widths. Besides natural finishes, softwood is often stained or painted.

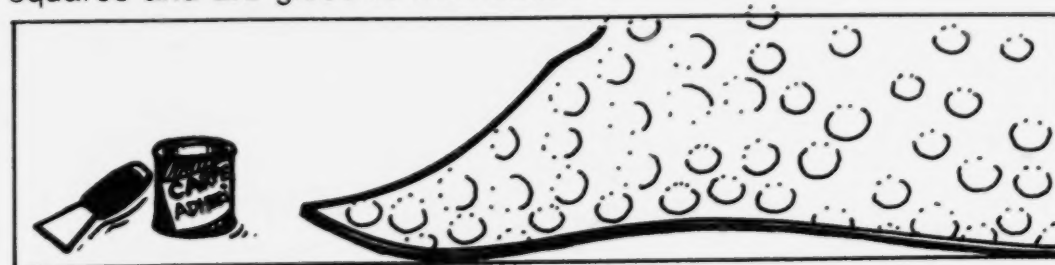
Wooden sheet flooring comes in 4'x 8' sheets and is often used as subflooring as well as finished flooring. Sheet flooring can be stained, painted, or have a natural top coat. The most often used wooden sheet floorings are plywood, chipboard, hardboard, and particleboard.



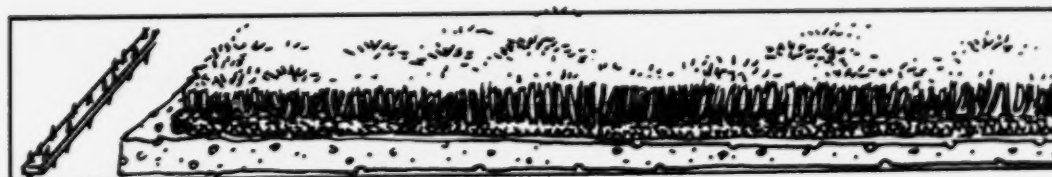
Another popular type of flooring is the hard surface type. Ceramic tile, quarry tile, mosaic, brick, terrazo, marble, stone, and slate coverings are glued to the subfloor and have the space between each piece grouted.



Soft flooring consists of cork, linoleum, rubber, thermoplastic, and vinyl. These types of coverings come in large sheets or tile-like squares and are glued to the subfloor.



Carpeting is used extensively as a floor covering. Carpets can be classified by material (natural or synthetic fibers), pile (cut, looped, or cut-looped), application (indoor-outdoor or home-industrial), and color.

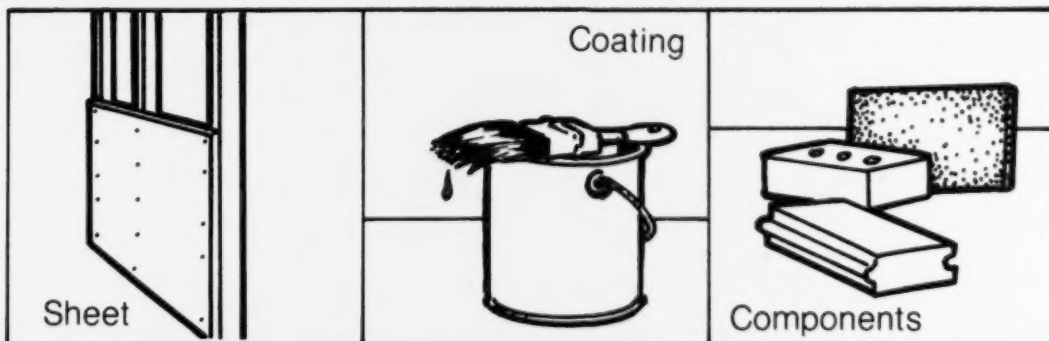


Carpet with a foam backing pad is usually glued to the subfloor. Carpet without a foam backing pad needs a separate pad underneath it. It is stretched across the floor and held in place with tack strips.

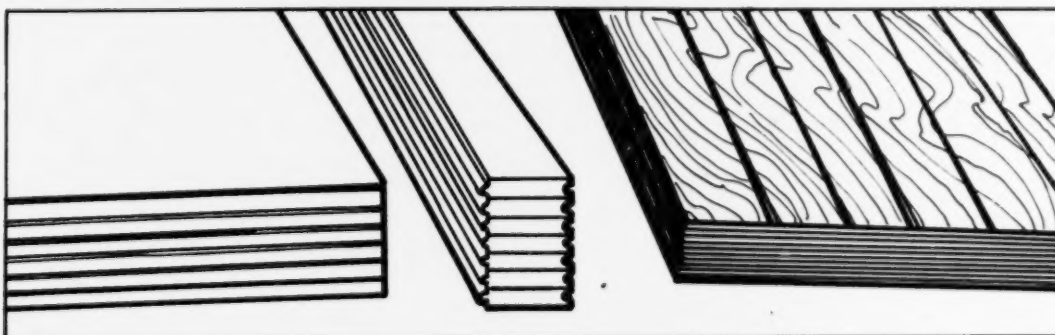


Wall Coverings

Materials used for wall coverings are limited only by one's imagination. They are chosen because of cost, durability, maintenance, and appearance. Wall coverings can be loosely divided into three broad categories: sheets, coatings, and small components.

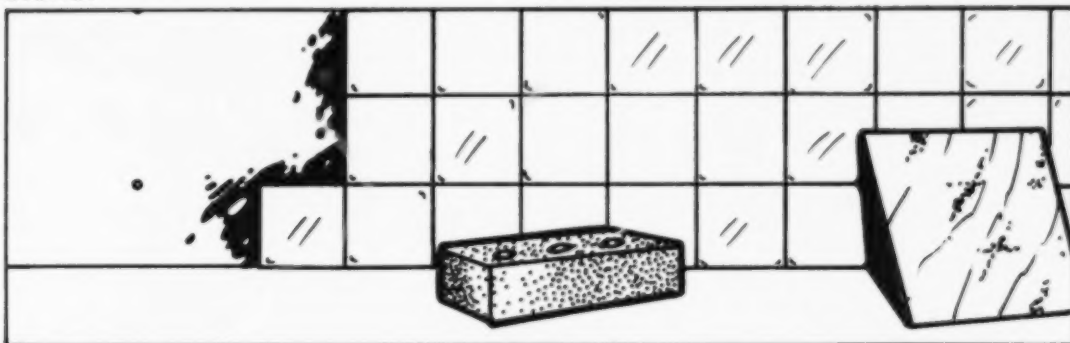


Sheet coverings are wall coverings that are attached (nailed, screwed, or glued) to the wall studs and support themselves. Some common sheet coverings are: sheetrock, paneling, tongue and groove boarding, softboard, and hardboard.



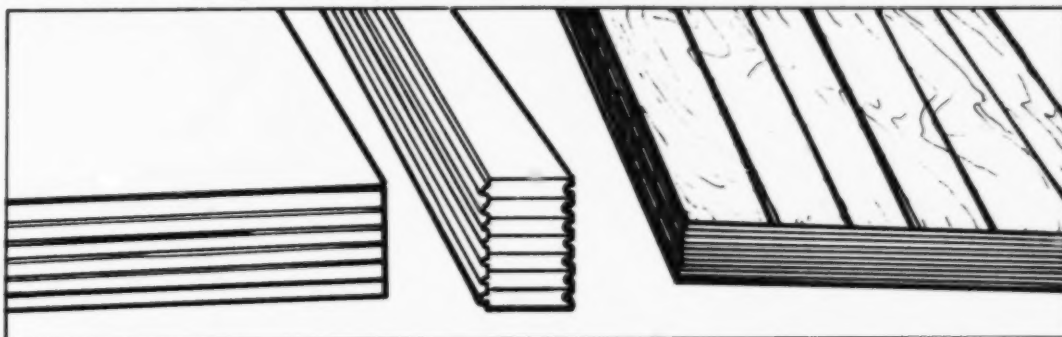
Wall coatings are not structural. They must be applied over some supportive structure like sheetrock or boarding. Wall coatings consist of paint, wallpaper, fabric, plaster, and textural coatings.

Small components are wall coverings that usually come in pieces. These types of wall covering are usually glued to a structural material for support and alignment. Typical small components are: ceramic, metal, quarry or vinyl tile, marble, slate, cork, mirror, terrazo, brick, or stone.



Ceiling Coverings

Ceiling coverings are usually chosen for cost, ease of installation, maintenance, acoustics, durability, and appearance. Ceilings come in three general types: coatings, sheets, and tiles.



Ceiling tiles are used extensively in modern homes. Most fall into the acoustic tile category. Acoustic tiles are designed to deaden sound. Ceiling tile is usually stapled to furring strips or held in a metal framework called a drop ceiling.

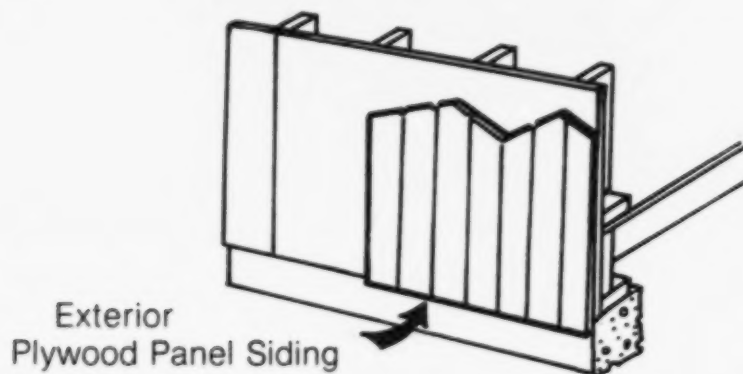


Exterior Wall Coverings

Exterior wall coverings are picked for cost, ease of installation and maintenance, durability, and appearance.

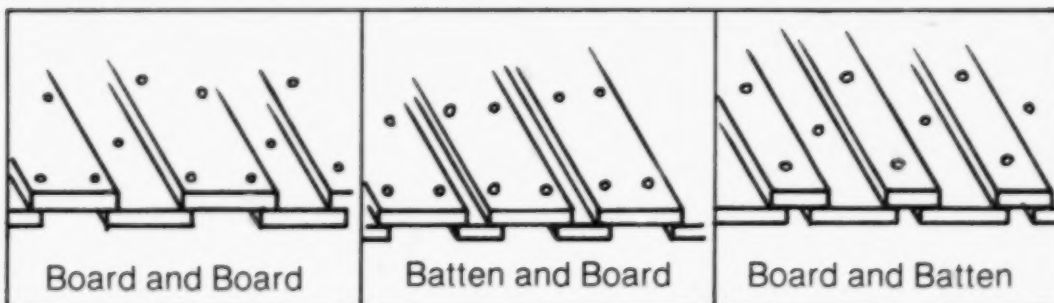
Several types of siding are common: sheet, board, shingle, woodlap, metal, vinyl, stucco, brick, and stone.

Sheet siding is usually 5/8" thick and comes in 2 or 4 foot widths of 8 or 9 foot lengths. Often, sheet siding has some form of texture (rough, stucco, etc.) and a grooving (usually vertical). Most sheet siding is made of redwood, pine, fir, cedar, or hardboard.



Board Siding

Board siding is mainly made of redwood, cedar, pine, or fir. Usually it is a vertical siding of dimensional lumber with special joints or bevels. Three common types of board siding are: board and batten, batten and board, and board and board.



Shingles

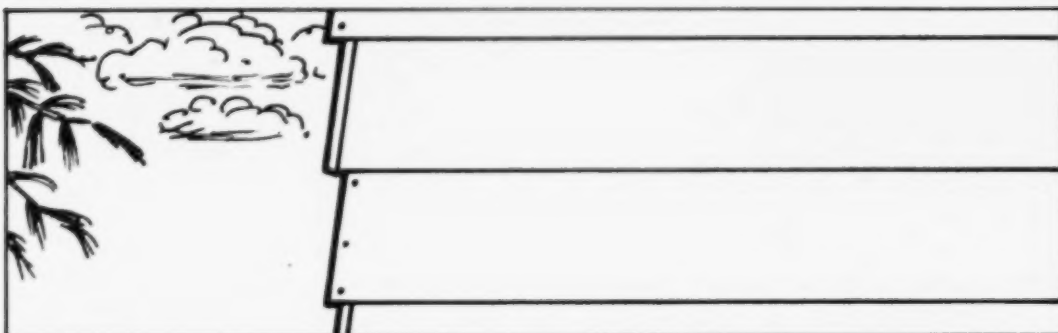
Wall shingles are usually made of cedar. They can be cut to produce decorative patterns.



Lap Siding

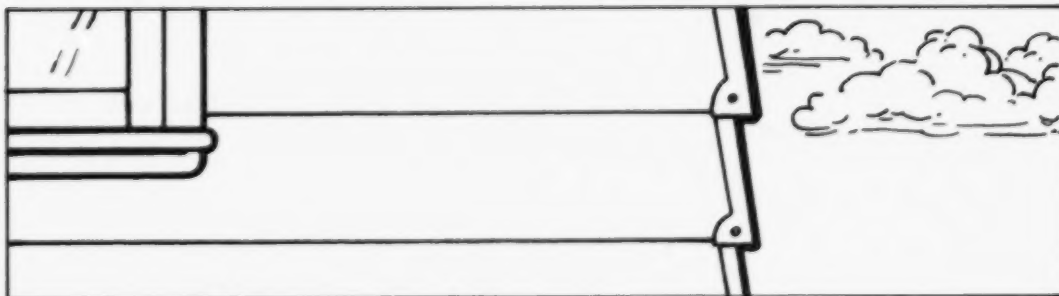
Lap siding is horizontal planking that is over-lapped to produce a weather-proof wall. Rain, for example, will run down the wall but will not come inside because of how the wall is lapped.

Lap siding can be made of wood, metal, or vinyl and comes in 8', 10', 12', 14', 16', and 18-foot lengths and 4", 6", 10", and 12-inch widths. There are several different joint types of lap siding.



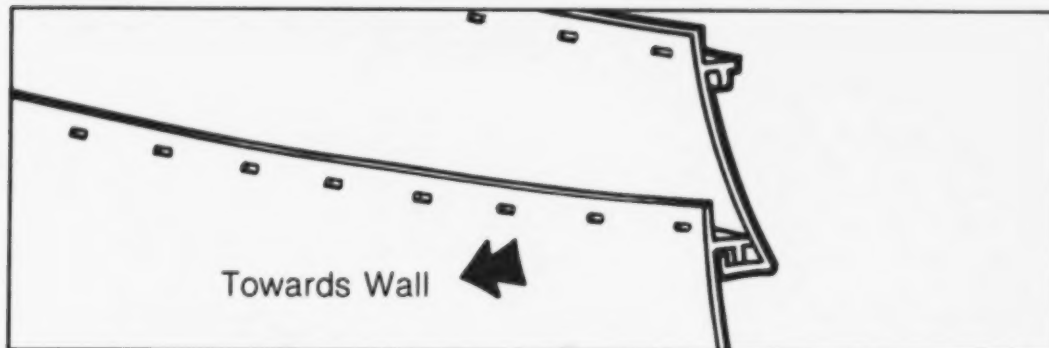
Metal Siding

Metal siding is made of steel or aluminum. Most metal siding is aluminum and comes prefinished with a baked-on enamel. This type of siding is often textured to look like wood grain and has a 3/8 inch rigid foam backing for insulation. The edges of metal siding interlock the color is in the material itself and not a coating so it never needs painting.



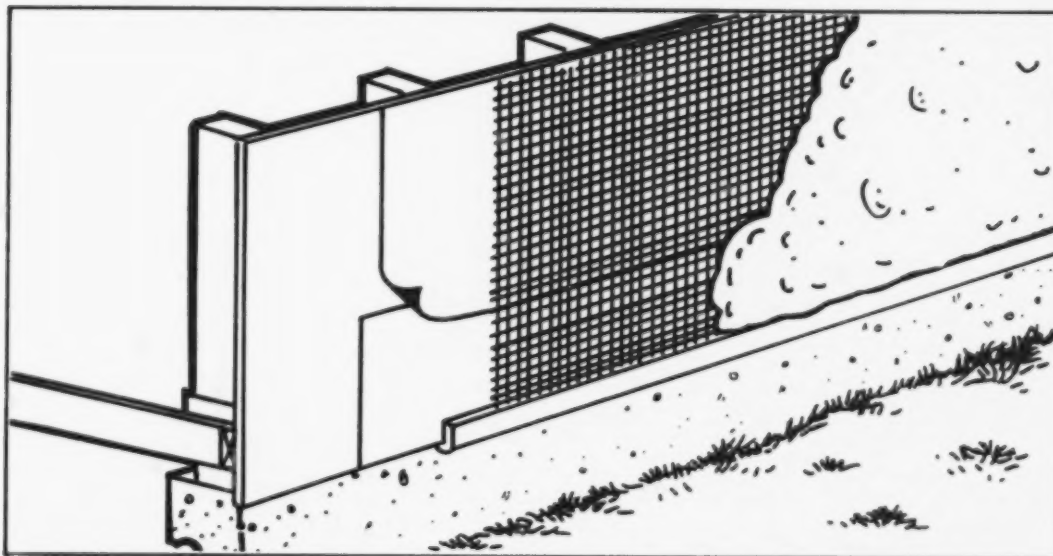
Plastic or Vinyl Siding

Vinyl siding is similar to metal siding. An advantage of vinyl is that the color is the material itself and not a coating so it never needs finishing.



Stucco

Stucco is a special type of exterior plaster that is applied over a screened metal mesh (wire lath).



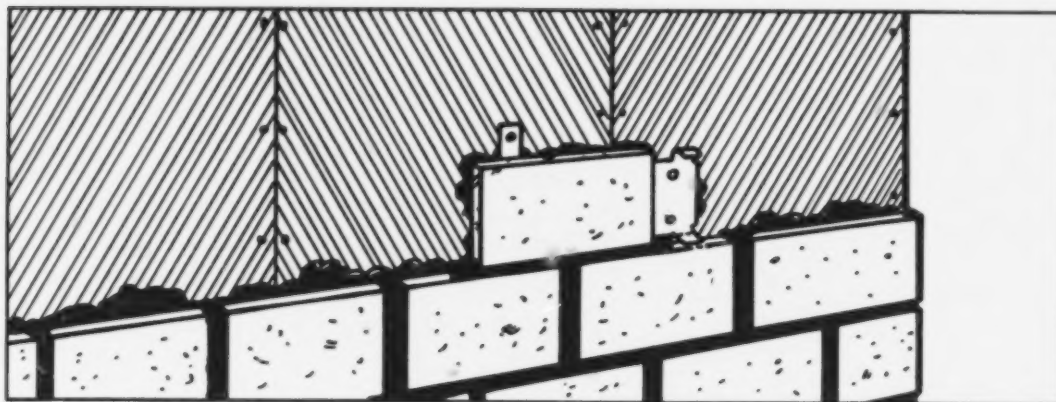
Stone

Stone is usually applied as a veneer over the standard sheathing of a structure. The stone is held to the sheathing with metal ties in the joints that have been screwed or nailed to the wall structure.



Brick Siding

Most modern brick homes are actually a single width of brick veneer laid outside the standard stud and sheathing framework. There are several types of brick veneers manufactured that are nailed or glued to the sheathing and mortared layer to simulate a common brick wall.



SEE YOUR INSTRUCTOR

Building Trades - Carpentry
Using Building Materials

Unit Review

Directions: Match each grade of lumber with its most common use by putting the correct letter in each blank.

- | | |
|------------------------|------------------------|
| ____ 1. Number 2 Grade | A. Utility Use |
| ____ 2. Number 3 Grade | B. Standard and Better |
| ____ 3. Number 4 Grade | C. Economy Use |

Directions: Match each type of lumber with its use by putting the correct letter in each blank.

- | | |
|-----------------------|---|
| ____ 4. Hardwood | A. Broadleaf wood used for flooring and furniture |
| ____ 5. Softwood | B. Thin plys of laminated lumber |
| ____ 6. Plywood | C. Sawdust and glue squeezed together under high temperature and pressure |
| ____ 7. Particleboard | D. Needle leaf or evergreen wood used for framing |

8. Calculate board feet for 3 - 2"x 6"x 8' pieces of lumber. Show your work.

$$\frac{(\text{Number of Pieces})(\text{Thickness''} \times \text{Width''} \times \text{Length''})}{\text{Square Inches}}$$

9. Calculate the square feet for a 10 foot x 10 foot room. How many 4' by 8' sheets of plywood will be needed to cover this area? Show your work.

$$\text{Square Feet in Room} = \text{Length} \times \text{Width}$$

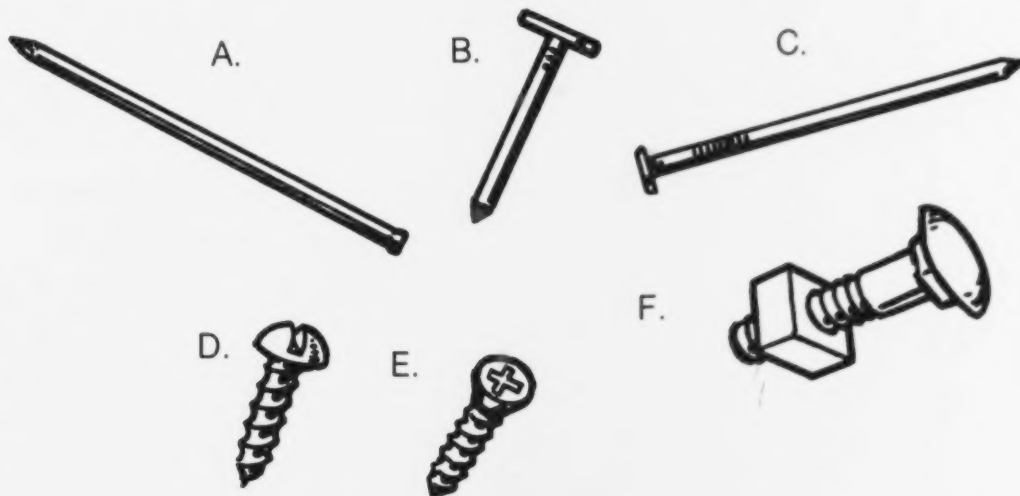
$$\text{Square Feet in Sheet} = \text{Length} \times \text{Width}$$

$$\text{Number of Sheets} = (\text{Area of Room})/(\text{Area of Sheet})$$

Directions: Match each illustration with its name by putting the letter in the correct blank space.

- ___ 10. Common Nail
- ___ 11. Finish Nail
- ___ 12. Roofing Nail

- ___ 13. Carriage Bolt and Nut
- ___ 14. Flathead, Phillips Screw
- ___ 15. Round Head, Single Slot Screw



Directions: Match the type of material listed in the second column with its category by writing the correct letter in each blank.

- ___ 16. Hardwood floor covering
- ___ 17. Softwood floor covering
- ___ 18. Sheet flooring
- ___ 19. Hard surface type
- ___ 20. Soft flooring
- ___ 21. Carpeting

- A. Linoleum
- B. Oak Tongue and Groove
- C. Foam Backed and Glued
- D. Grouted Mosaic
- E. Pine Tongue and Groove
- F. 4'x 8' Plywood

Directions: Match the methods of attachments to the wall and ceiling coverings by putting the correct letter in the blank.

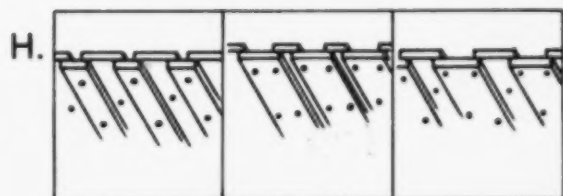
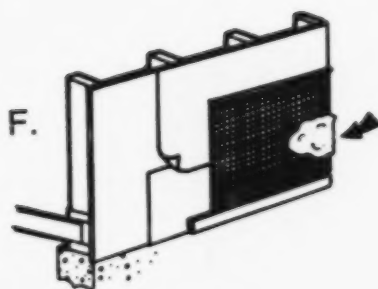
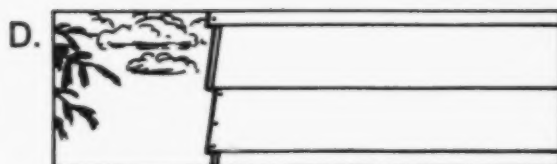
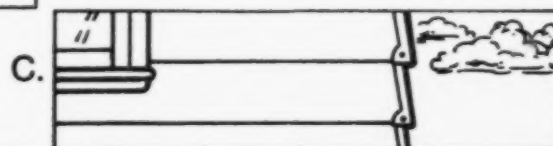
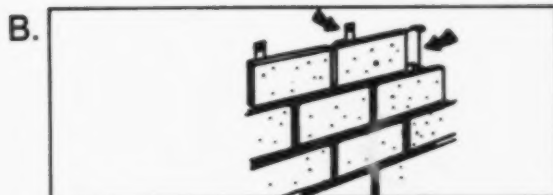
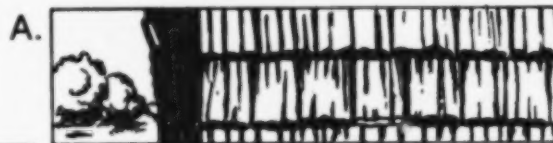
- ___ 22. Coatings
- ___ 23. Sheets
- ___ 24. Small Components

- A. Attached to wall studs and support themselves
- B. Applied over a supportive structure
- C. Small pieces glued or attached to a support

Directions: Match the pictures to the types of exterior siding by putting the correct letter in each blank.

- ___ 25. Shingles
- ___ 26. Lap Siding (wood)
- ___ 27. Metal Siding
- ___ 28. Brick

- ___ 29. Stucco
- ___ 30. Plastic/Vinyl Siding
- ___ 31. Boardsiding
- ___ 32. Stone



Building Trades - Carpentry
Using Building Materials

Performance Checklist

Student _____ has successfully performed the following steps of procedure.

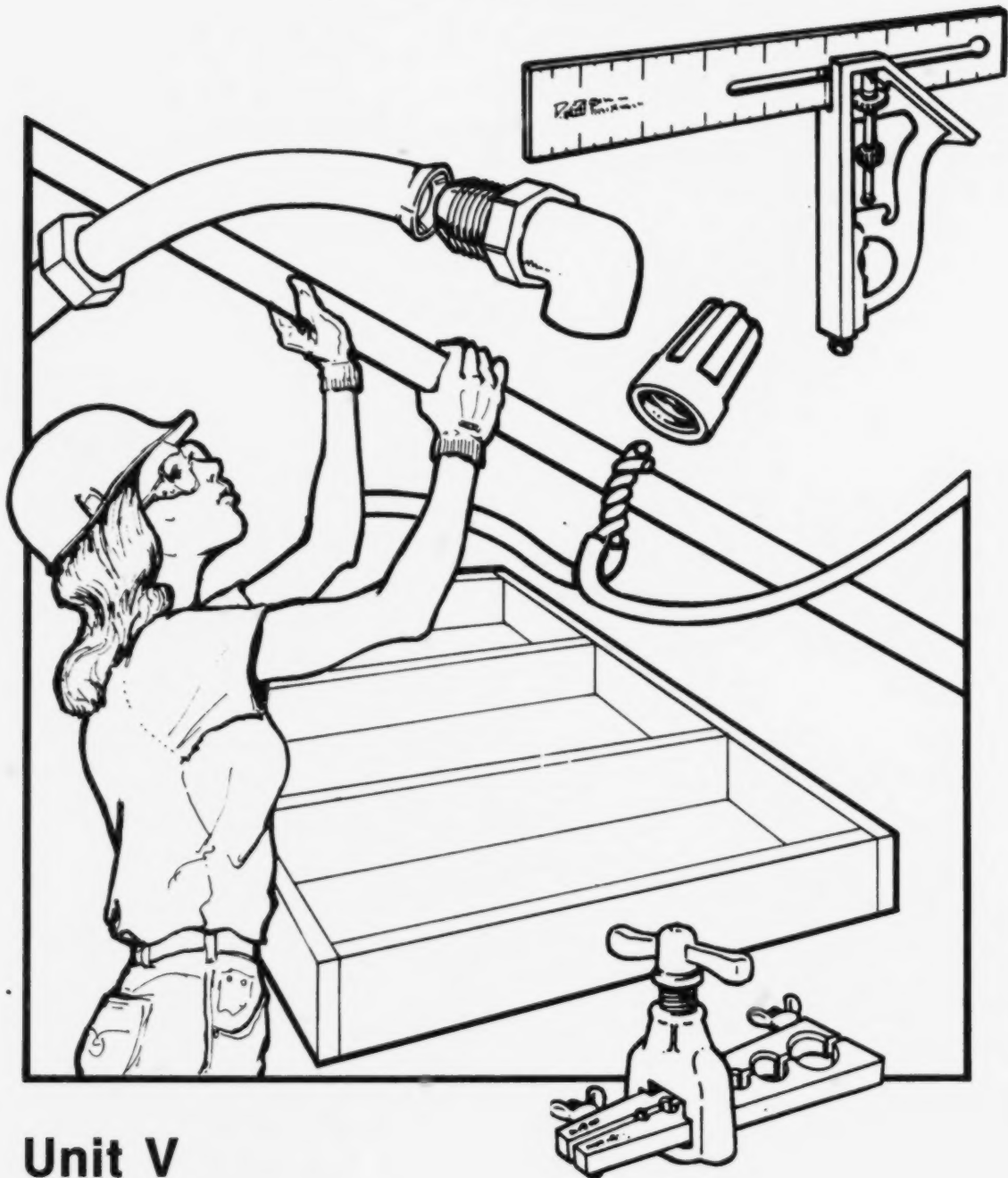
Recognizing lumber types, sizes, and grades	Yes	No	Comments
1. Recognized types of lumber			
2. Recognized sizes of lumber			
3. Compared grades of lumber			
Calculating building materials	Yes	No	Comments
1. Calculated board feet			
2. Calculated square feet			
Identifying fastening devices	Yes	No	Comments
1. Identified types and sizes of nails			
2. Identified types of screws			
3. Identified types of bolts			
Identifying interior and exterior coverings	Yes	No	Comments
1. Identified floor coverings			
2. Identified wall coverings			
3. Identified ceiling coverings			
4. Identified exterior wall coverings			

Should Move On ☐

Repeat This Unit ☐

 Student's Signature/Date

 Instructor's Signature/Date



Unit V

Cutting and Measuring Materials

Building Trades - Carpentry

Cutting and Measuring Materials

Cutting and Measuring Materials

After studying this unit, you will be able to:

1. Read a tape measure or rule.
2. Layout, square, and cut lines to specifications.
3. Describe level, square, and plumb.

Check the Statement that Fits You Best

☐

I can do these tasks and want to go through the
Performance Checklist.



SEE YOUR INSTRUCTOR

☐

I want to study the information in this unit before I
do the Performance Checklist.



TURN PAGE AND BEGIN

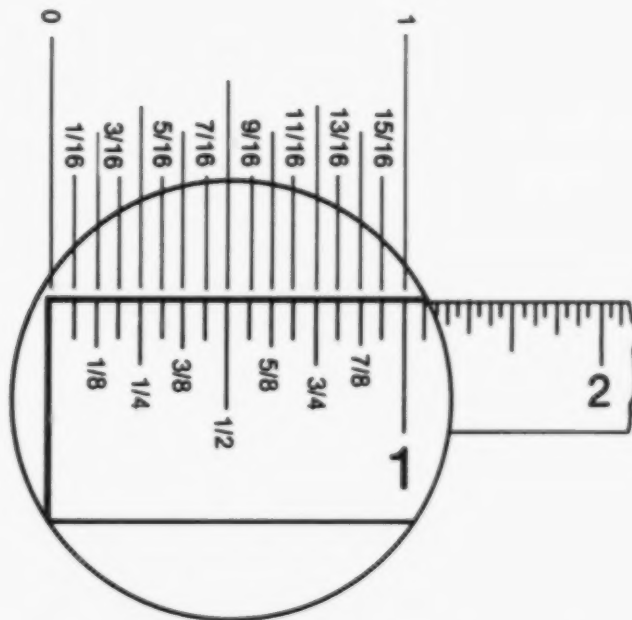
Building Trades - Carpentry

Cutting and Measuring Materials

Introduction

Probably the most important single skill which you as a building trades worker can have is the ability to read a rule. Without this ability, nothing can be laid out accurately and you cannot build anything accurately.

To accurately construct something from what you cut and assemble, you must be familiar with the concepts of square, level, and plumb. When a person has mastered measuring and cutting skills and can use those skills to insure level, square, and plumb; that person has mastered some of the most important basic skills of building trades.



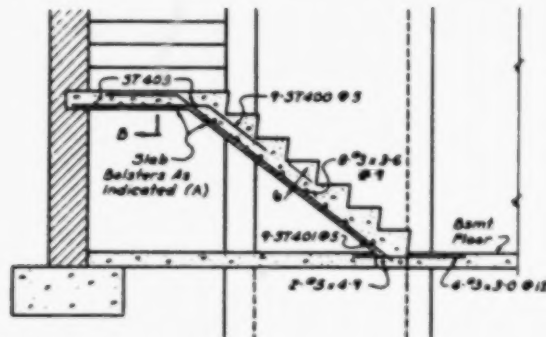
In this unit you will learn to measure building materials accurately, layout, square, and cut materials to specifications.

TURN TO NEXT PAGE

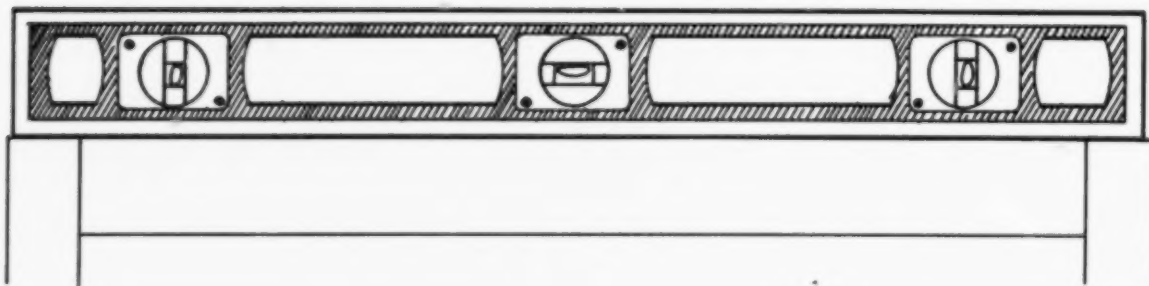
Building Trades - Carpentry
Cutting and Measuring Materials

A. Terms and Equipment for Cutting and Measuring

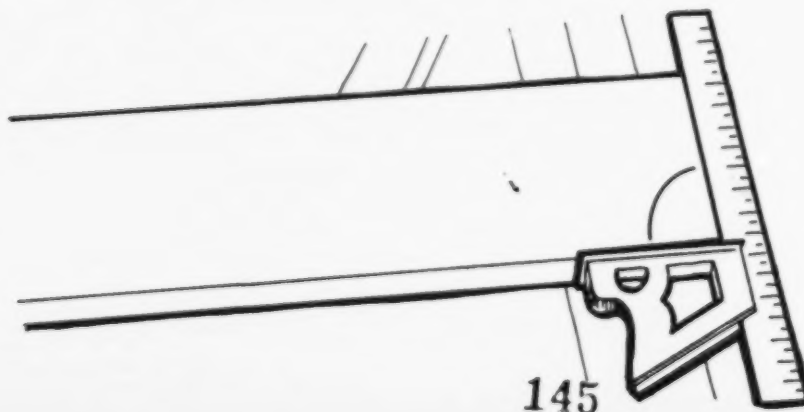
1. Specifications: size, dimension, kind, quality, and quantity of materials and workmanship needed for a construction job



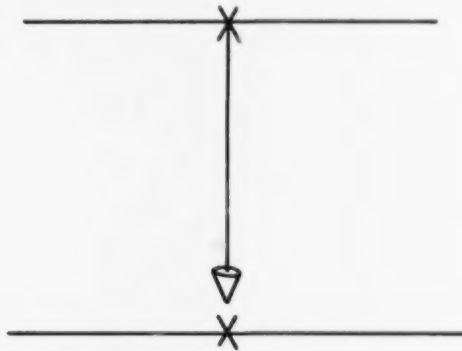
2. Level: a condition of being exactly horizontal



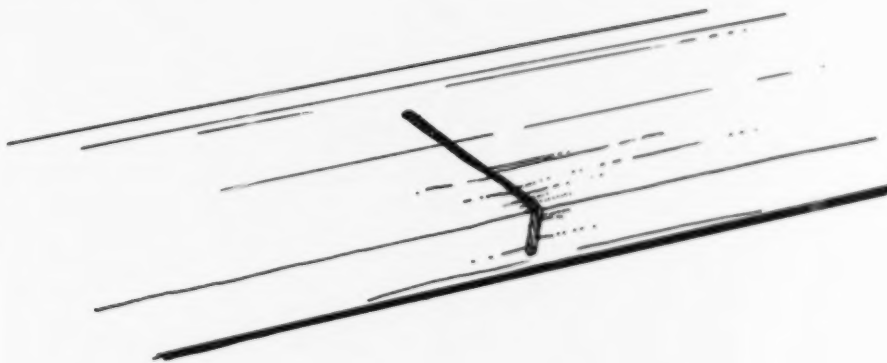
3. Square: a condition where corners are exactly 90° and a structure fits together correctly



4. Plumb: a condition of being exactly vertical, or at a 90° angle to the horizon or floor



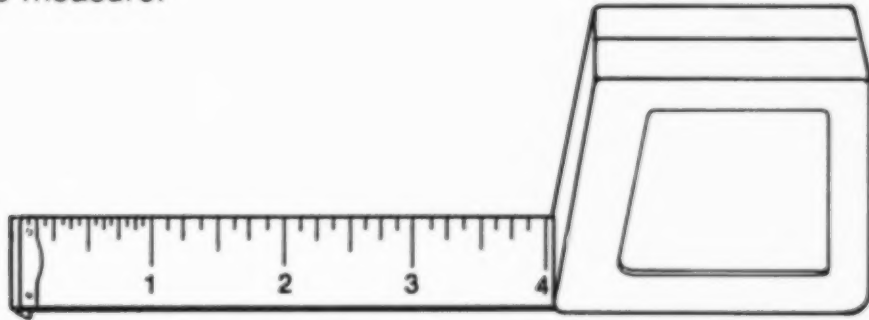
5. Kerf: the cut of a saw



Building Trades - Carpentry
Cutting and Measuring Materials

B. Steps for Reading a Tape Measure or Rule

1. Obtain a tape measure.

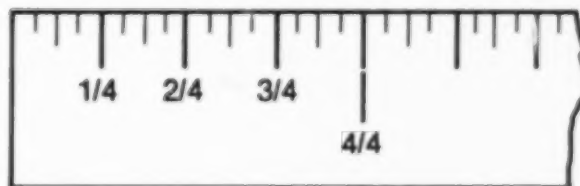


2. Study the marks on a tape measure to determine the numbers for whole inches. There are 12 inches in a foot and there are:

2 halves in an inch 8 eighths in an inch
4 quarters in an inch 16 sixteenths in an inch

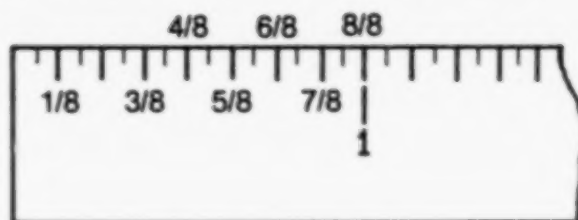


3. Look at and learn the quarter marks ($1/4$ of an inch) on your rule. Any measurement you are trying to take will be close to one of the quarter marks.

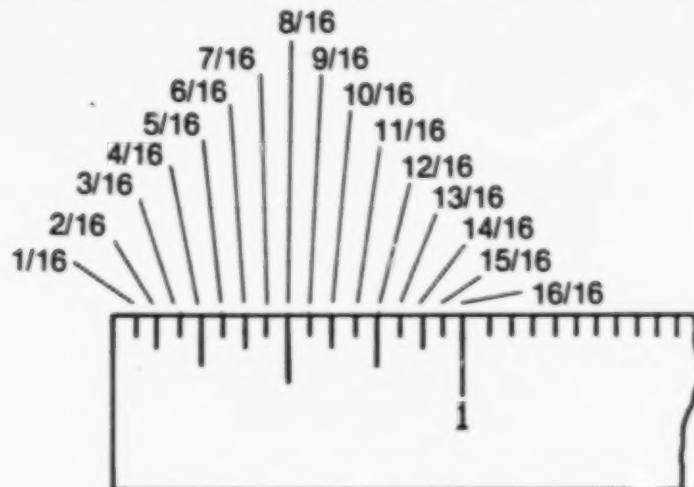


Note: $1/2$ of $1/2 = 1/4$ $1/2$ of $1/4 = 1/8$
Just double the bottom number.

4. Divide each of these quarters into half. Now you have eighths ($\frac{1}{8}$ of an inch).



5. Divide each of the eighths in half. Now you have sixteenths ($\frac{1}{16}$ of an inch).



6. Read the rule by first stating the whole number and then the fraction. For example, 2 and $\frac{1}{2}$ inches.

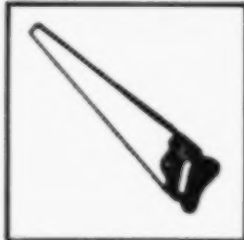


7. Get Skill Sheet 1 and do the exercises on it.
8. See your instructor when you finish or if you have any questions.

Building Trades - Carpentry
Cutting and Measuring Materials

C. Steps to Layout, Square, and Cut Lengths to Specifications

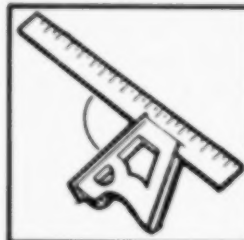
1. Assemble the following tools and materials.



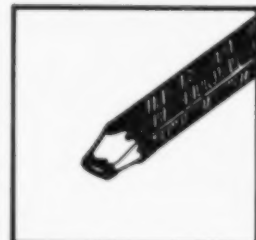
Hand Saw



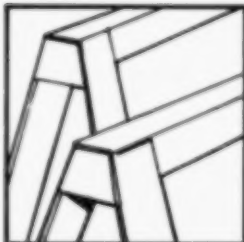
Tape Measure



Square



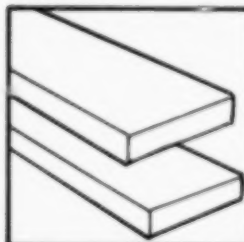
Pencil



Saw Horses

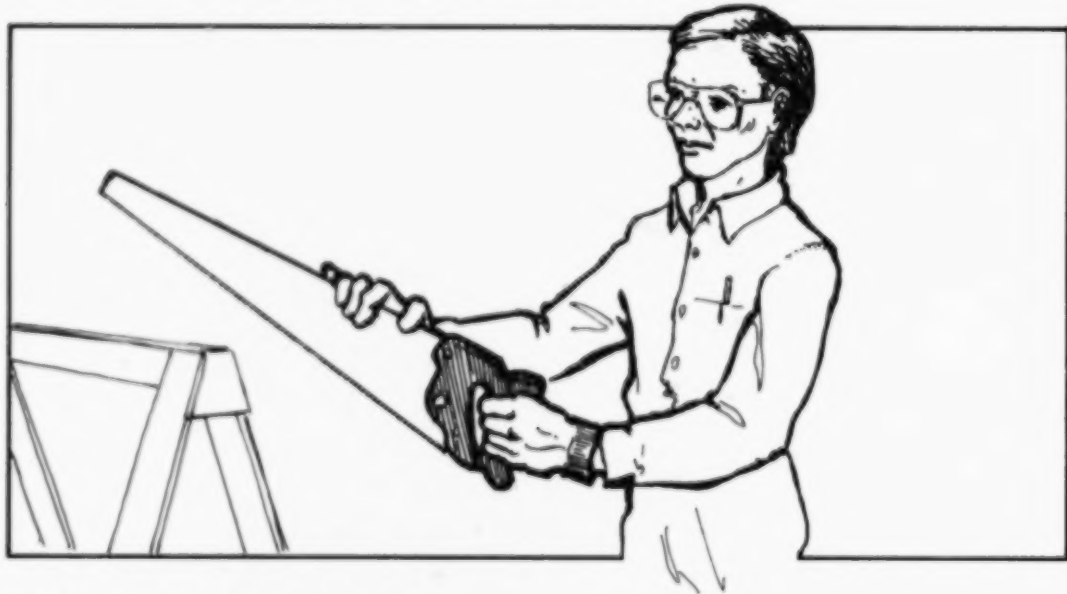


Safety Equipment



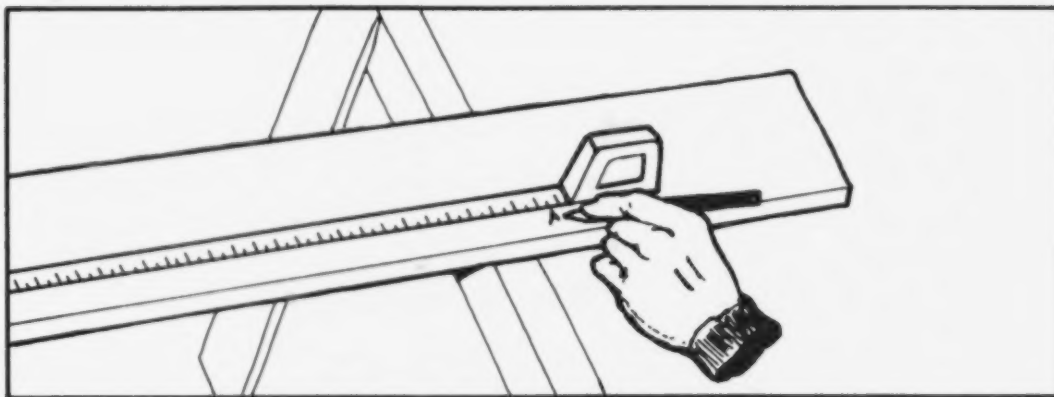
Lumber

2. Put on safety glasses and gloves and get hand saw.

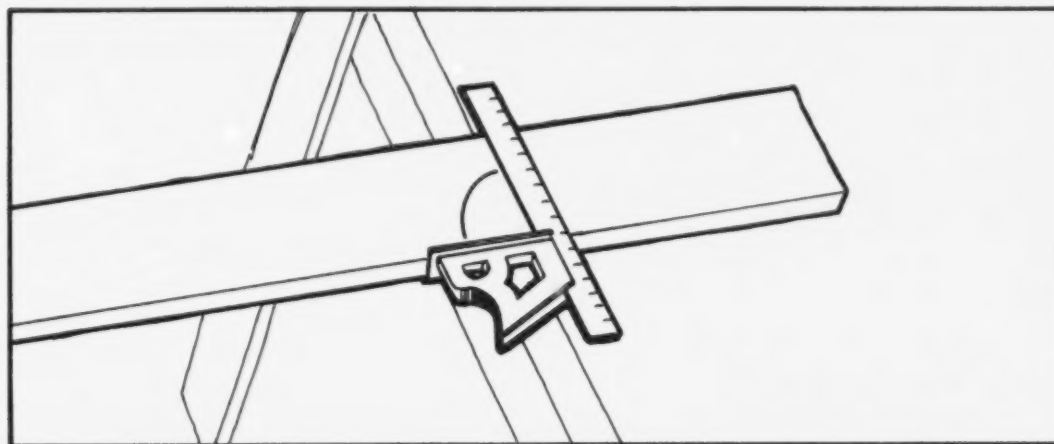


3. Place lumber on saw horses.

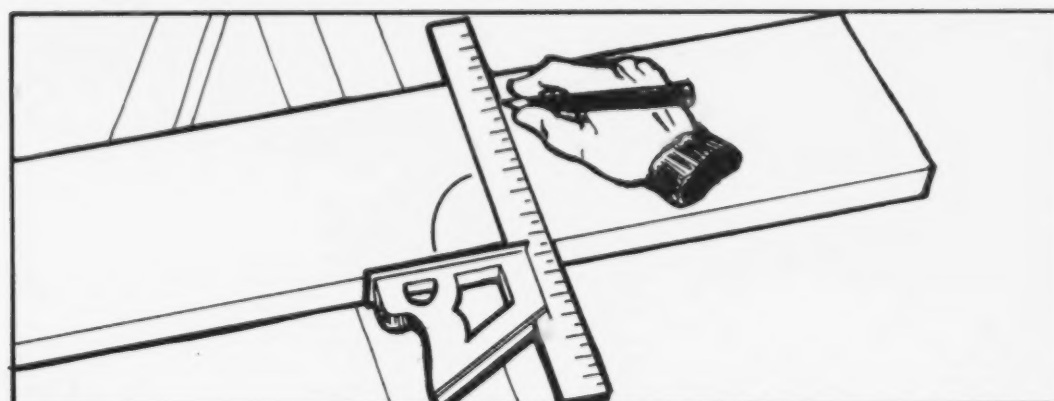
4. Measure the length to be cut and mark it with the pencil.



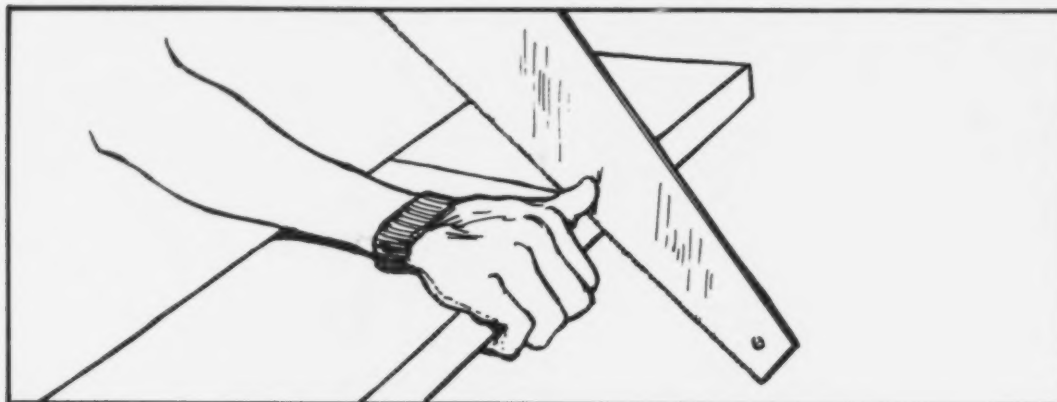
5. Place the square against the front edge of the board and across the top.



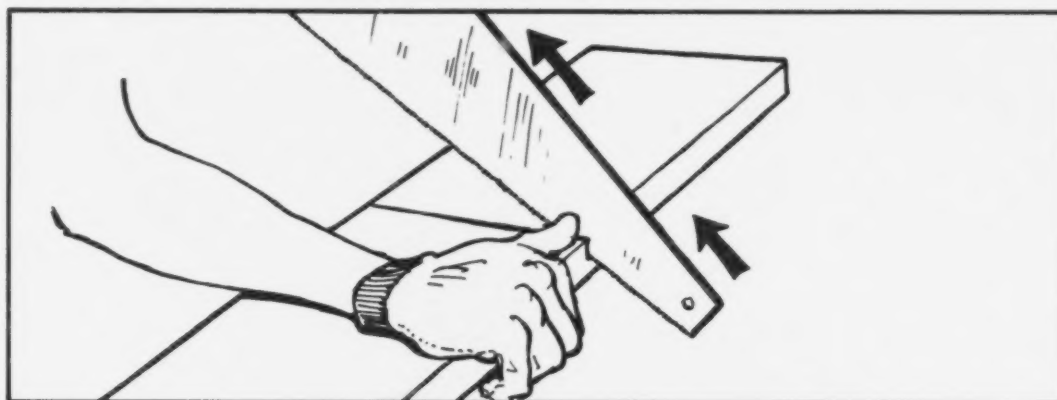
6. With the pencil, mark a squared line across the lumber at the specified length.



7. Place the blade of the hand saw on the cutting mark. Place your thumb against the side of the saw blade for support.



8. Pull the saw back slowly to begin the cut.



9. Use long, smooth forward and backward strokes to cut. Follow the pencil line.



10. Use a twisting motion to bring the saw back to the cutting line if it starts to wander.

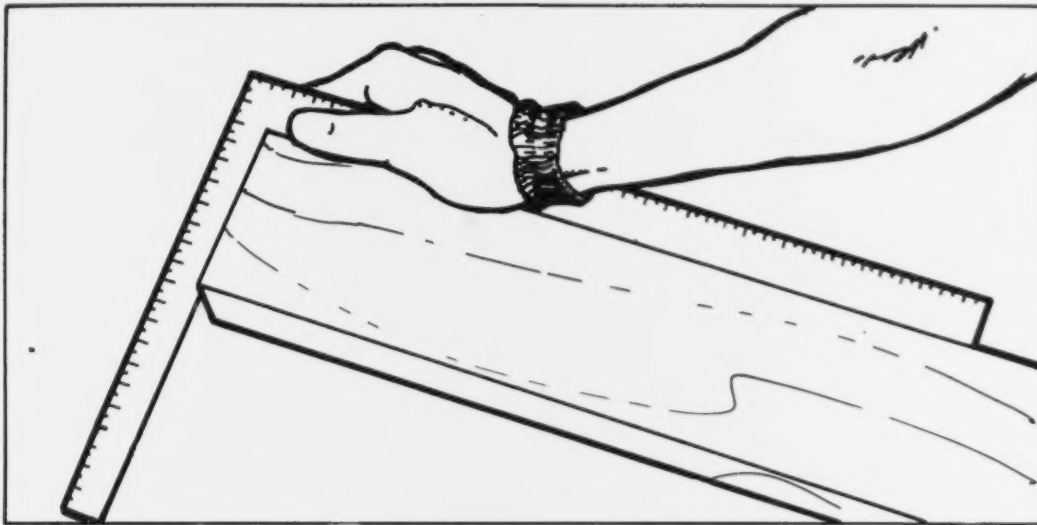


11. Use your hand to support the end being cut.



12. As you approach the end of the cut, shorten the length of the stroke.

13. Use a framing square to check your cut.



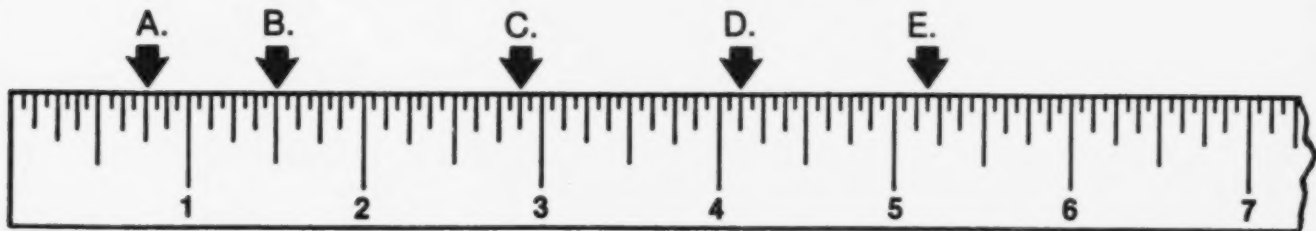
14. Discuss the cuts with your instructor if you have problems.
Practice as much as needed.
15. Clean work area and return tools to their proper places when finished.

SEE YOUR INSTRUCTOR

Trades - Carpentry
Cutting and Measuring Materials

Skill Sheet 1
Reading Fractions on a Rule or Tape

Directions: Write the correct length in each blank.



1. A. = _____
2. B. = _____
3. C. = _____
4. D. = _____
5. E. = _____

Directions: Mark the correct distance on the lines below.

6. $3\frac{3}{4}$ inches



7. $1\frac{1}{4}$ inches



8. $3\frac{10}{16}$ inches



9. $2\frac{1}{2}$ inches



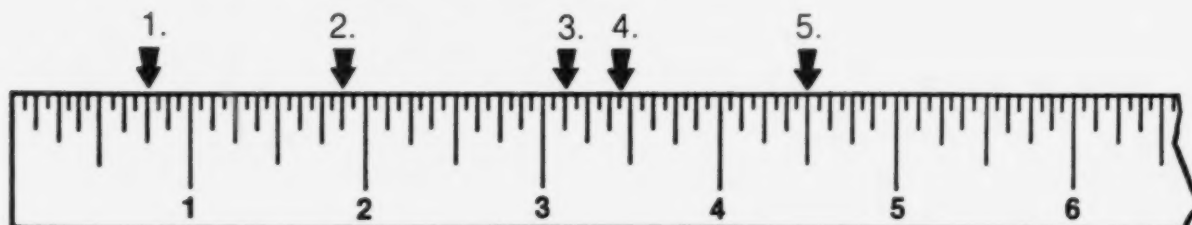
10. $2\frac{5}{8}$ inches



Building Trades - Carpentry
Cutting and Measuring Materials

Unit Review

Directions: Write the correct length for each of the measurements below in the blanks provided.



1. _____

2. _____

3. _____

4. _____

5. _____

Directions: Match the word with its correct meaning by putting the correct letter in the blank space.

_____ 6. Level

_____ 7. Square

_____ 8. Plumb

A. a condition where corners are exactly 90°

B. a condition of being exactly horizontal

C. a condition of being exactly vertical (90° to the floor)

Building Trades - Carpentry
Cutting and Measuring Materials

Performance Checklist

Student _____ has successfully performed the following steps of procedure.

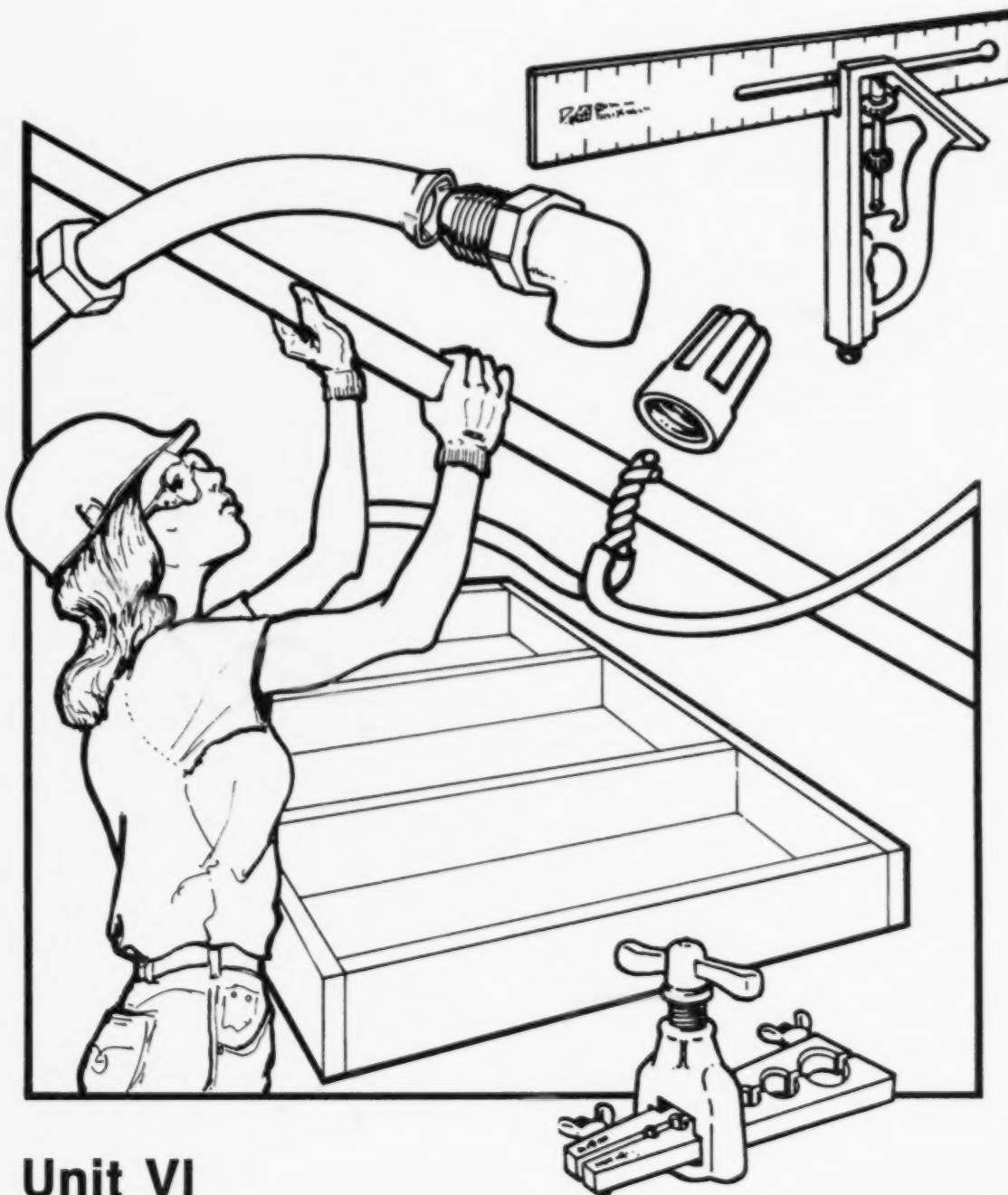
Reading a Tape Measure or Rule	Yes	No	Comments
1. Measured given materials to the sixteenth of an inch			
Laying Out, Squaring and Cutting Lengths to Specifications	Yes	No	Comments
1. Assembled tools and materials			
2. Put on safety glasses and gloves			
3. Put lumber on sawhorses			
4. Measured and marked the length to be cut			
5. Placed the square on the board			
6. Marked the cutting line with a pencil			
7. Placed handsaw blade on the cutting mark and supported it with thumb			
8. Pulled saw back slowly			
9. Used long smooth strokes to cut along pencil line			
10. Supported the end being cut off			
11. Shortened strokes near the end of the cut			
12. Checked cut with square			
13. Showed work to instructor			
14. Cleaned work area and returned tools to proper places			

Should Move On ☐

Repeat This Unit ☐

 Student's Signature/Date

 Instructor's Signature/Date



Unit VI

Framing

Framing

Framing

After studying this unit, you will be able to:

1. Distinguish among floor, wall, and roof framing members.
2. Build a section of floor.
3. Construct two wall sections.
4. Figure the pitch of a roof.

Check the Statement that Fits You Best

☐

I can do these tasks and want to go through the Performance Checklist.



SEE YOUR INSTRUCTOR

☐

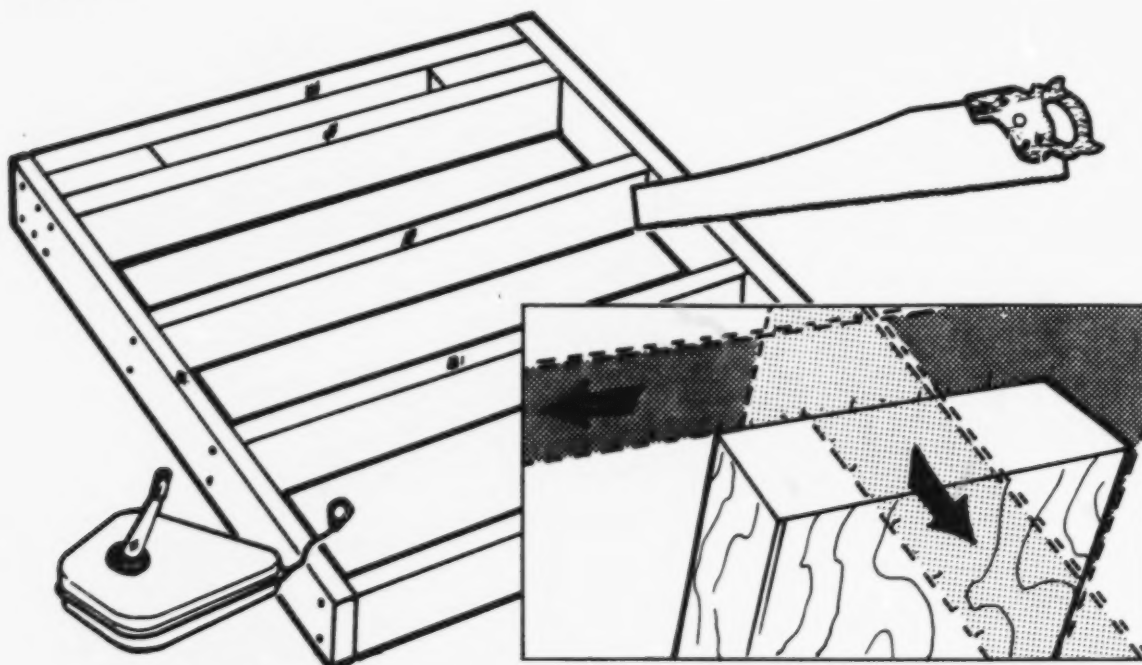
I want to study the information in this unit before I do the Performance Checklist.



TURN PAGE AND BEGIN

Introduction

Wood frame construction is the major type of house framing used today. Wood has several economic advantages. It is easy to get, less expensive than most other framing materials, and versatile to use. High quality and accurate framing is important for the life span and soundness of the house.



Framing is separated into three distinct sections: floor, walls, and roof framing. The terms used for each of these framing sections may at first seem confusing. However, the more you use the terms, the more you will see a commonsense logic to them.

TURN TO NEXT PAGE

Framing

A. Terms Used in House Framing

1. Blueprint - a set of plans from which a structure is built
2. On-Center (O.C.) - distance from the center of one object (stud or joist) to the center of the next object
3. Framed-Up - to build or construct framing
4. Joist - horizontal beams used to support the floor or ceiling
5. Subfloor - a rigid material (plywood or particleboard) nailed to the floor joists to form a smooth, level surface for the finished floor covering
6. Crown - the highest point of the crook (or bow) in a board - this point is often called the "up-side"
7. Flush - having surfaces in the same place; even or level
8. Tack - to temporarily or sparingly nail together
9. Layout - to arrange or make according to a plan or blueprint
10. Nail Off - to finish nailing something with all the required nails usually after it has been tacked
11. Chalk - to use a chalk box and line to mark stock
12. Stud - Upright members in framework of a wall that supports the wall coverings and roof
13. Plates - framing members that hold studs in place and to the floor. The top plate is the upper member and is usually doubled. The sole plate is the bottom member attached to the flooring.
14. Rough Opening (R.O.) - Oversized openings in the rough framing into which doors and windows are installed
15. Header - the special support member in the top of R.O. to support the roof across the R.O.
16. Trimmer - a modified stud that goes under a header and next to a stud to add extra support to the header

17. Load Bearing Wall - a wall that supports more structure weight above it
18. Non Load Bearing Wall - a wall whose purpose is to divide the floor space and not support any weight of the house
19. Rafter - sloping roof member that rests on the walls and supports the roof structure
20. Truss - a modified, prefabricated rafter system capable of supporting loads over long spans
21. Ridge - the highest horizontal line of the roof
22. Span - the horizontal distance a roof covers from the outside of one exterior wall to the outside of the opposite exterior wall
23. Rise - the total vertical distance that a rafter rises from the top plate to the ridge
24. Run - the total horizontal distance a rafter measures from the ridge to the outside of the exterior wall it rests on; usually $\frac{1}{2}$ of the span
25. Line Length - rafter length from the ridge to the outside edge of the top plate; it is the long side of a right triangle formed by the run, the rise, and the rafter

Framing

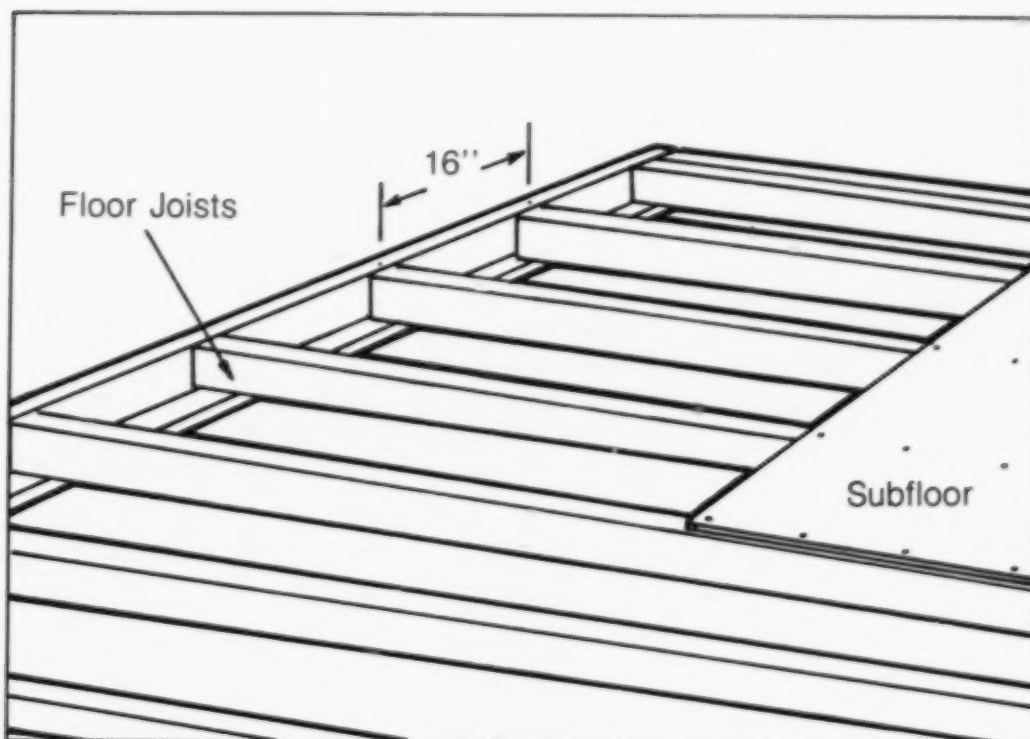
B. Distinguishing Among Floor, Wall, and Roof Framing

Floor Framing

Framing construction is done by working from a set of drawn plans showing the building plans on paper. This set of plans is a blueprint.

House framing starts with the floor. Floor framing members are called floor joists. Floor joists are evenly spaced on center (center to center) every 16 inches or two feet. The end joist will have a double joist for reinforcement. The floor joists rest on a sill plate and girder for support and their ends are nailed to headers.

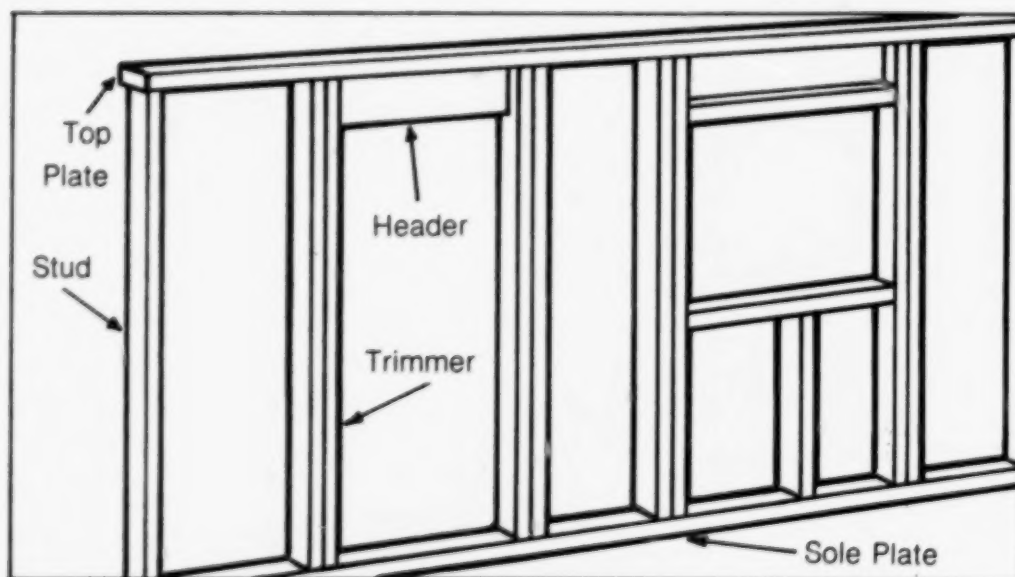
Floor joists provide a level framework for the subfloor. This subflooring is usually a rigid material (like plywood or particleboard) which is nailed to the floor joist for support. This support forms a safe and level surface to frame-up and erect the wall section.



Wall Framing

Vertical members of a wall are called studs. They are comparable to joists. In order to hold the studs in place, they are attached to a bottom and a top wall member. The top member is a top plate. The bottom member, nailed to the subflooring, is a sole plate. These plates allow interior and exterior walls to be built flat and erected as a unit.

An opening for a door or window is called a rough opening or R.O. An R.O. is made oversized so the window or door can be easily installed and squared. The finish trim will cover any gaps later.



In order for the wall to carry the weight of the roof over the R.O.'s, a special frame member called a header is used. A stud called a trimmer is then doubled up with a full stud to support the header and help it carry the extra weight.

Walls are also either load bearing or non load bearing. A wall that supports what is above it (the weight of the roof or another floor) is called a load bearing wall. If a wall simply divides a floor space into rooms and does not bear any overhead weight, it is a non-load bearing wall.

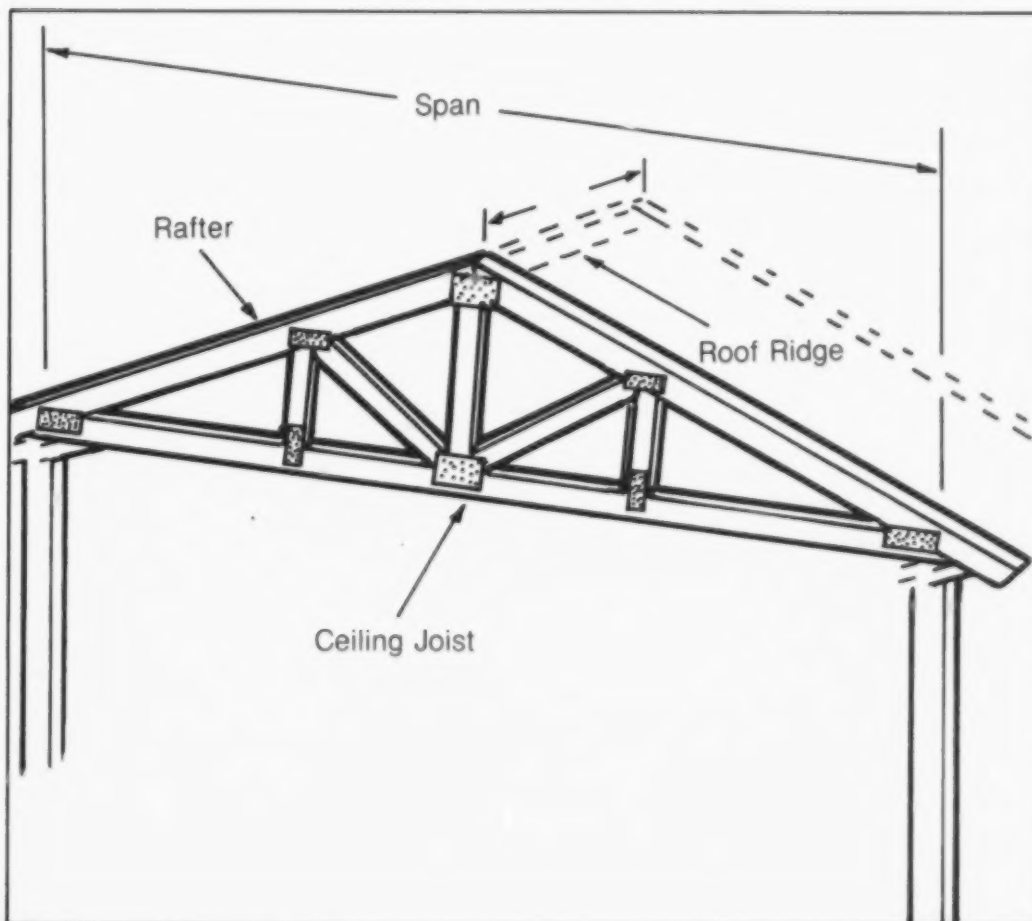
Roof Framing

Roof framing can be done in a variety of styles. Regardless of the style, the same construction members and terms are used.

A rafter is the sloping roof member that supports the roof decking and covering. They are usually spaced at 16 inches on center and are attached to the roof ridge (highest horizontal line of the roof), top plate of the exterior walls, and ceiling joists. Ceiling joists serve the same purpose that the floor joists do.

A modified rafter called a truss is used in modern construction. Trusses are used because they can support the roof over large spans and are easier and faster to put up. They can be constructed on the ground then raised to the roof and nailed in place.

The span of a roof is the horizontal distance a roof covers from the outside of one exterior wall to the outside of the opposite exterior wall. Span does not include the overhang.



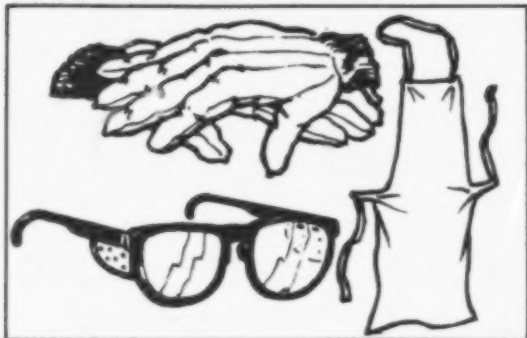
Building Trades - Carpentry

Framing

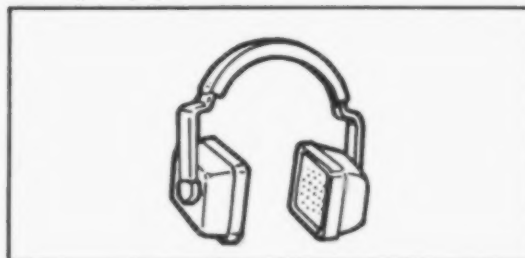
C. Building a Section of Floor

1. Assemble the following tools and supplies.

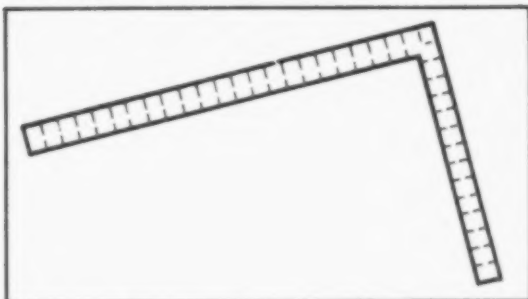
Safety Equipment



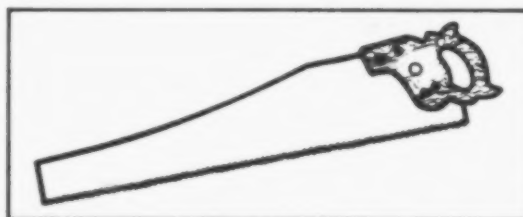
Safety Equipment



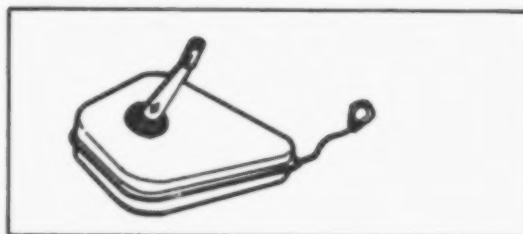
Framing Square



Saw



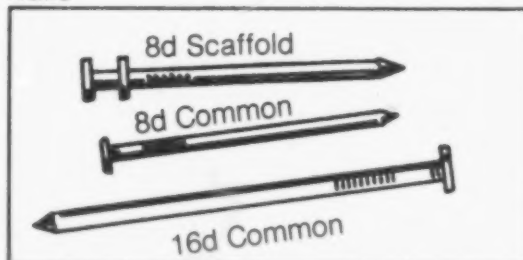
Chalk Paddle



Hammer



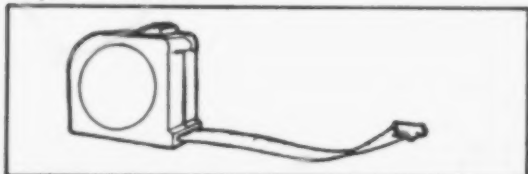
Nails



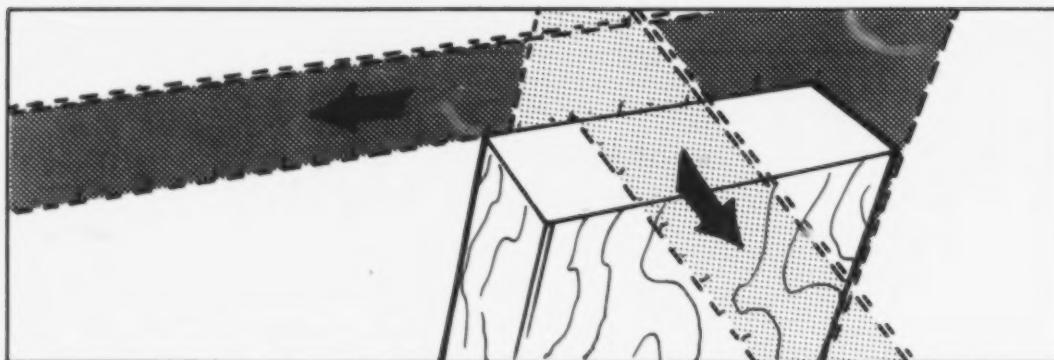
Pencil



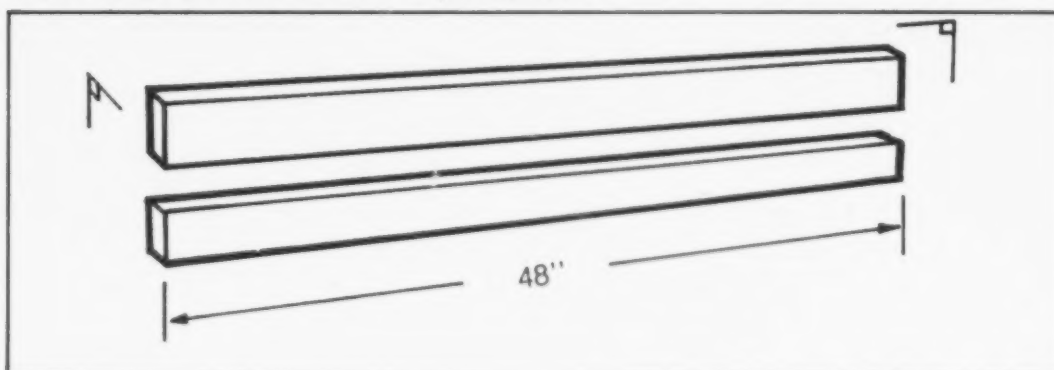
Tape Measure



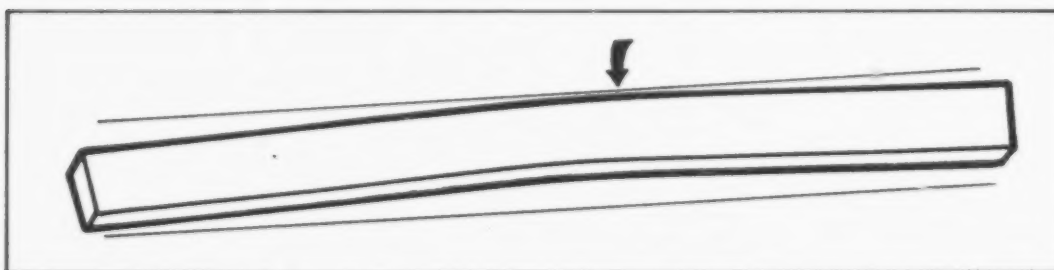
2. Check one end of each joist stock for square. Be sure to check for square *BOTH* ways.



3. Layout and cut two header joists 2"x 4"x 48." Cut one at a time. Check each cut for squareness.



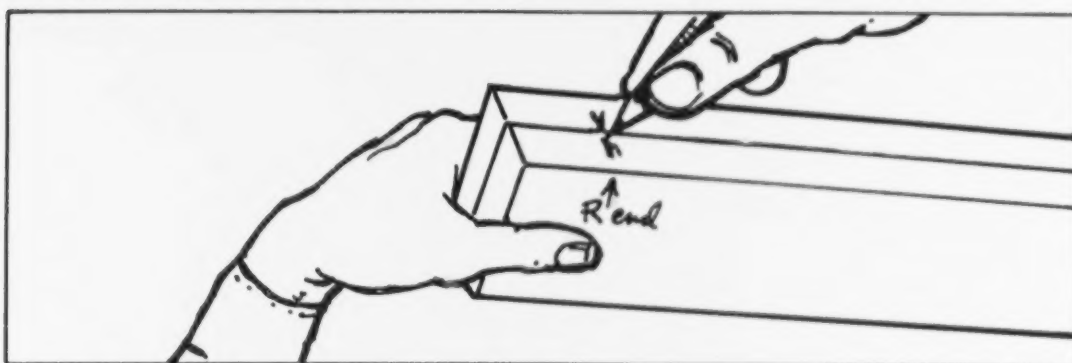
4. Check each board for crown. Mark the center of the "high" side.



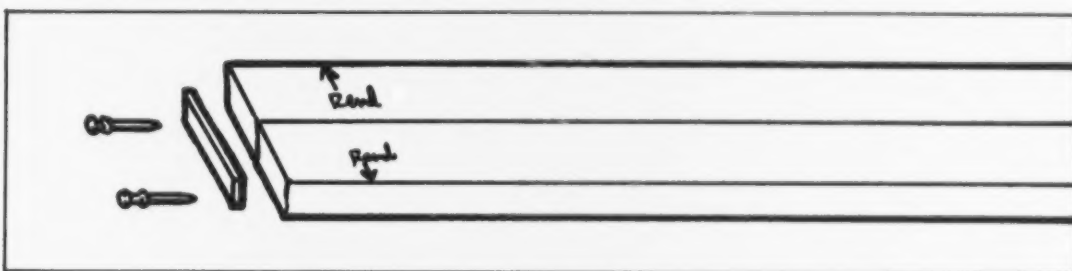
5. Hold or clamp the two header joists together. Be sure to have crowns out, edge to edge, and ends flush.



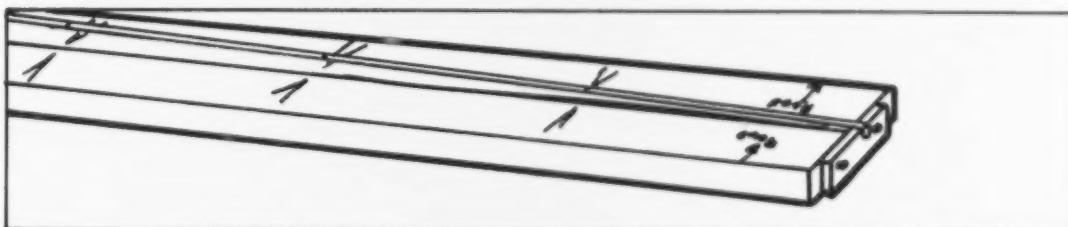
6. Mark one end of each header to keep the pair matched when nailing the joists together.



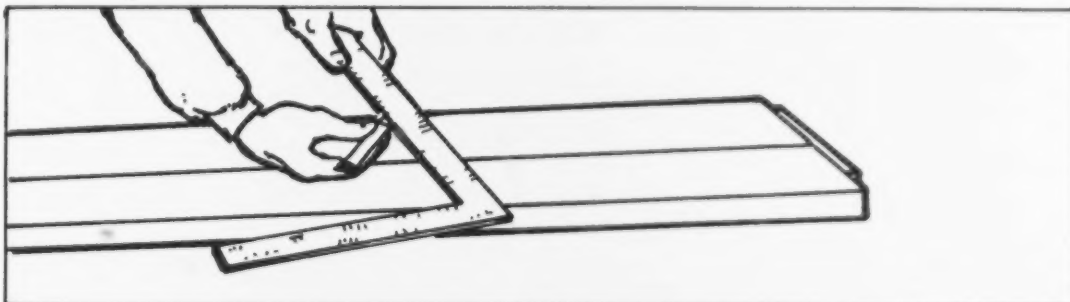
7. Tack a $\frac{3}{4}$ " x $1\frac{1}{2}$ " x 6" piece of wood to the marked ends of the header joists. (Use scaffold nails)



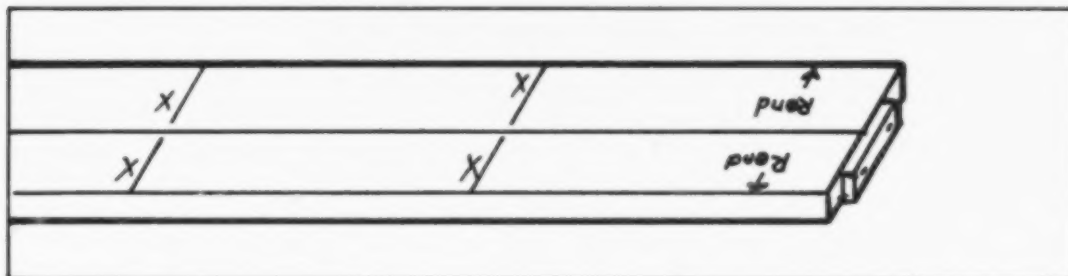
8. Using a tape measure, mark off 16" centers where the two interior floor joists will fit. (You don't have to mark the end joists because they flush to the ends of the header joists.)



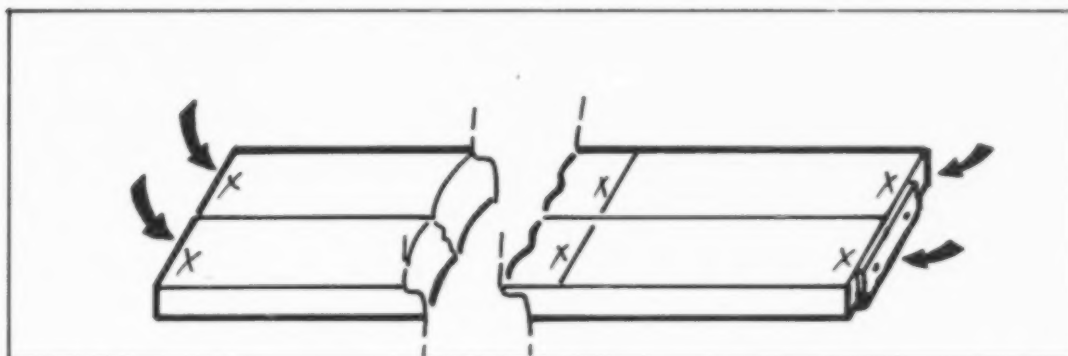
9. Using a framing square, draw square joist lines across both header joists.



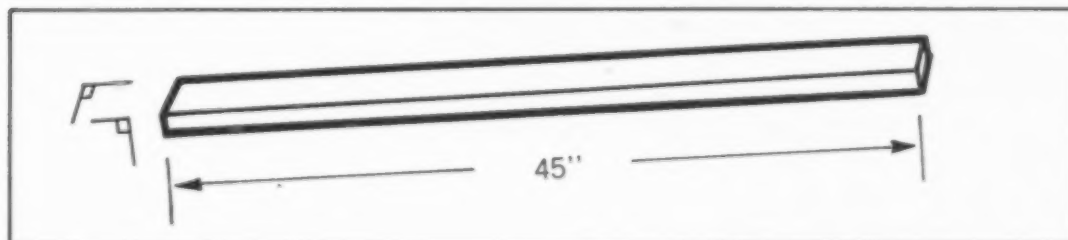
10. Put an X opposite the scrap block side of each line. This marks the side of the line where the floor joists will go.



11. Put an X at the edge of each header too. This will remind you where the two end joists will go.



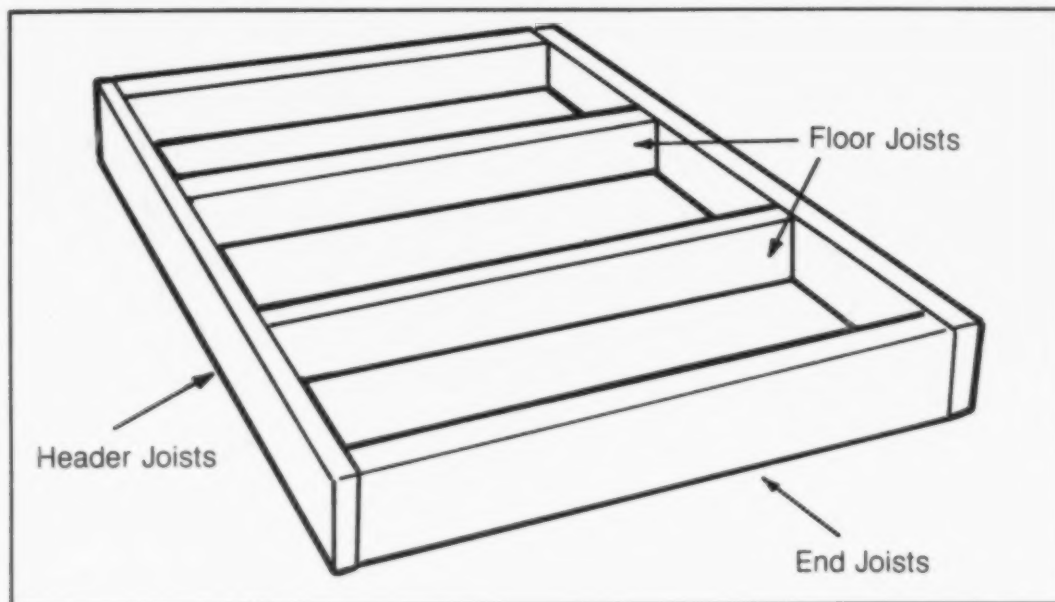
12. Remove the scrap block. (Use a hammer or pry bar.)
13. Layout and cut two end joists and two floor joists 2"x 4"x 45." Cut one joist at a time and check each for square.



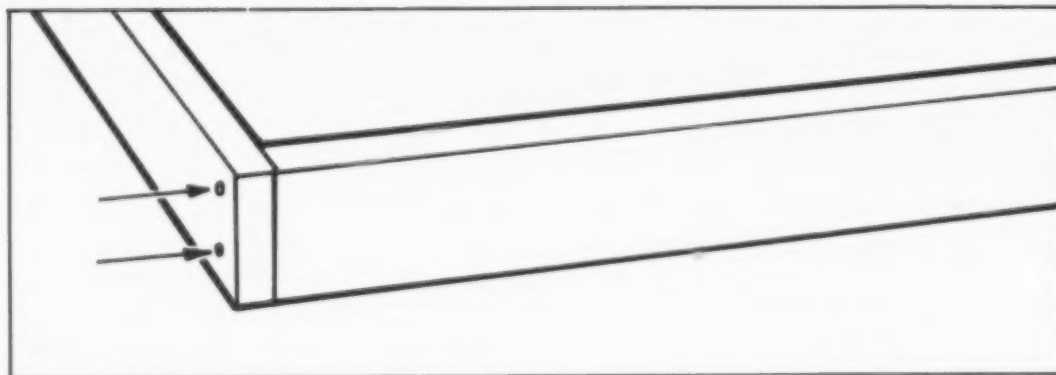
14. Check all four joists for crown and mark the up side.



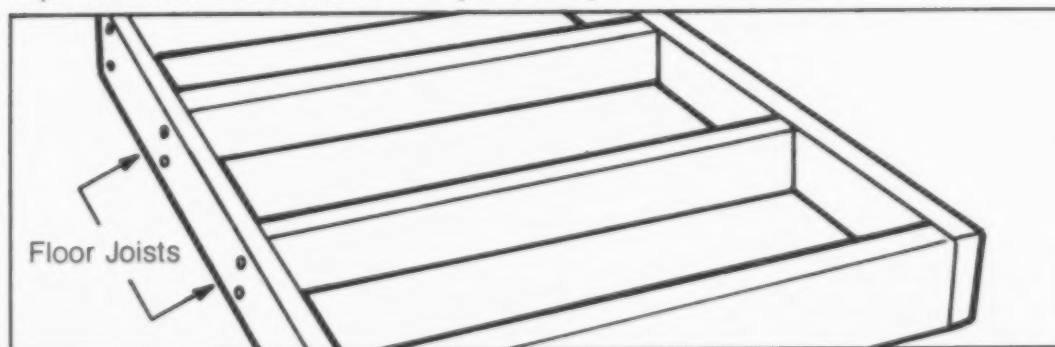
15. Layout header joists, end joists, and floor joists with crowns up.



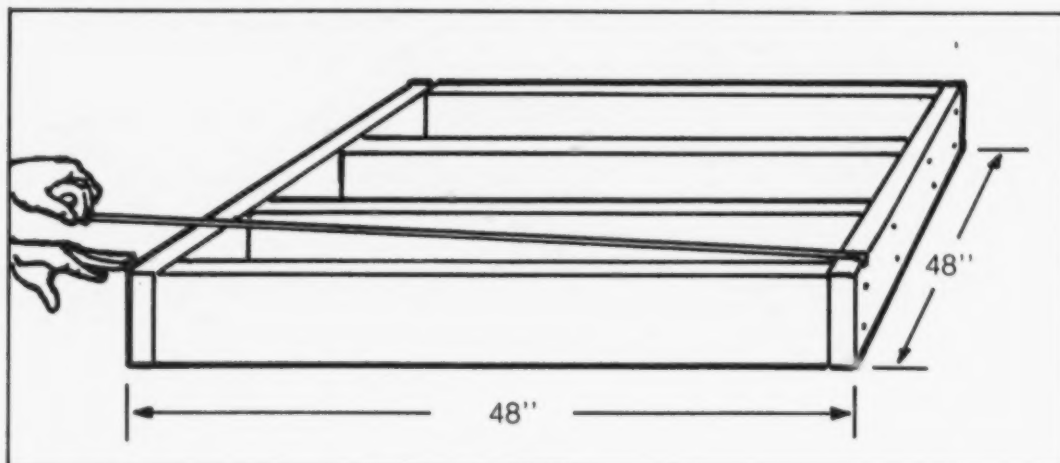
16. Drive two 16^d nails through the header into each end of both end joists (Be sure they are flush and cover the X's.)



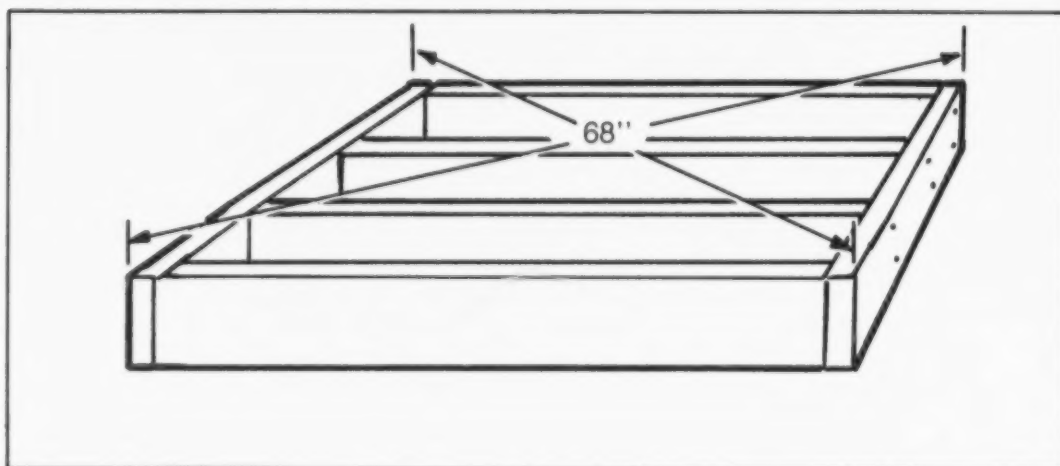
17. Drive two 16^d nails through the headers into the ends of each floor joist. Be sure the joist covers the X and touches the squared line on center. Always flush joists to header.



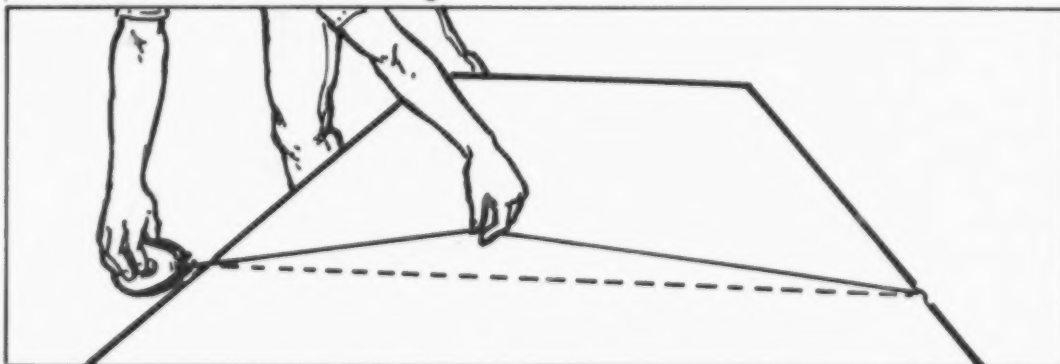
18. Check the unit with a tape to be sure it measures 48"x 48."



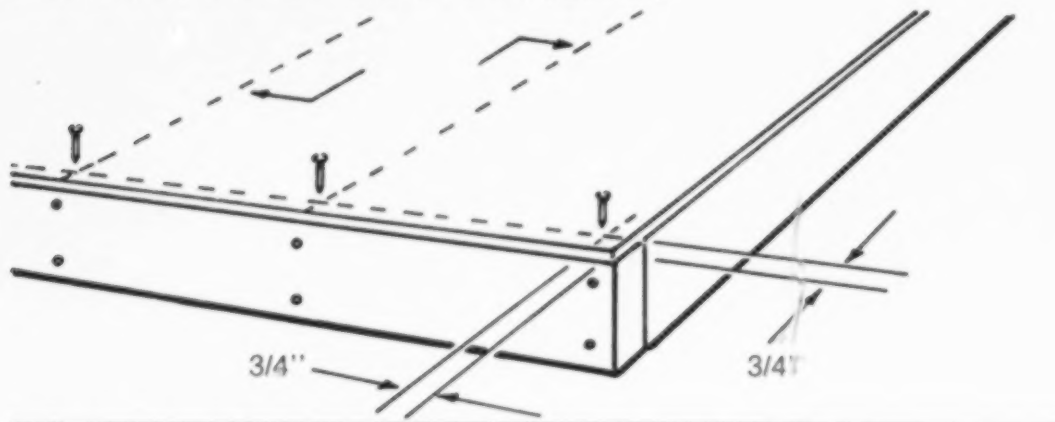
19. Check the unit for square by measuring the two diagonal measurements. If the diagonals are the same, the unit is square. If the diagonal is not square, use a clamp to shorten the longest diagonal to equal the other.



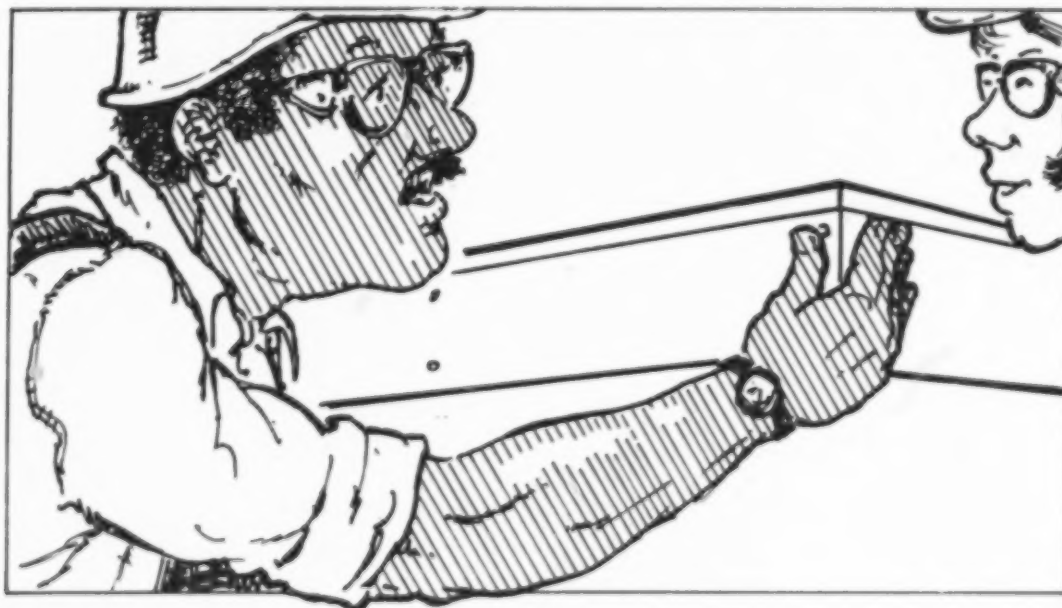
20. Chalk a line and cut out a 48"x 48" square piece of plywood or particleboard for subflooring.



21. Lay the subfloor on top of joists and tack it $\frac{3}{4}$ " from the corners and joist ends with 8^d nails. (You can tell where the joist ends are by the 16^d nails on the headers.)



22. Chalk nail lines down the center of the two floor joists by using the tacked 8^d nails as your guides.
23. Nail off subfloor to all joists using 8^d nails on 8" centers. (There should be 7 nails to each side.)
24. Have your instructor inspect your work.

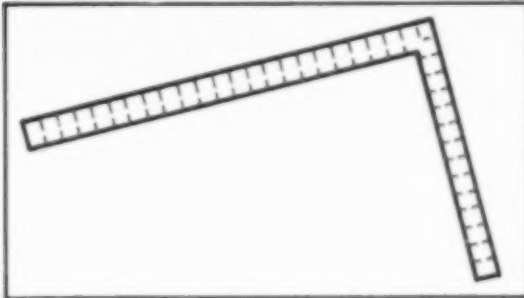


Building Trades - Carpentry
Framing

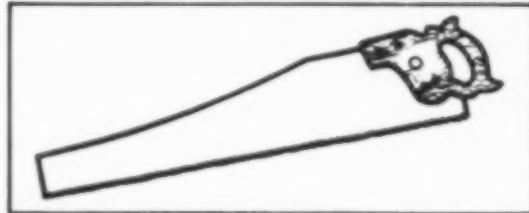
D. Constructing Two Wall Sections

1. Assemble equipment and supplies.

Framing Square



Saw



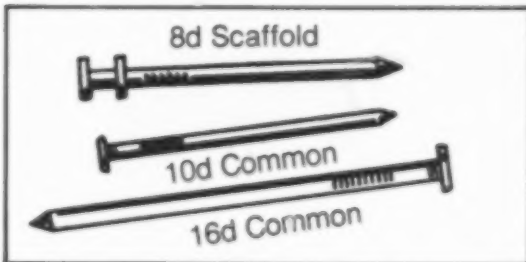
Pencil



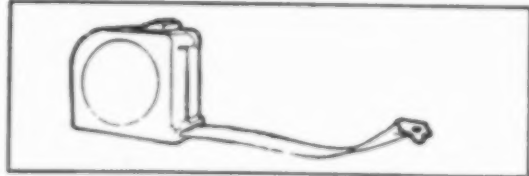
Hammer



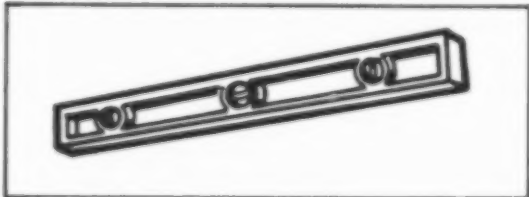
Nails



Tape Measure

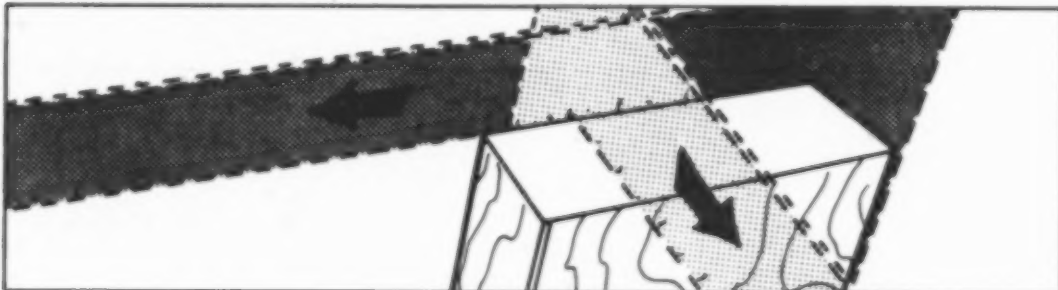


Level

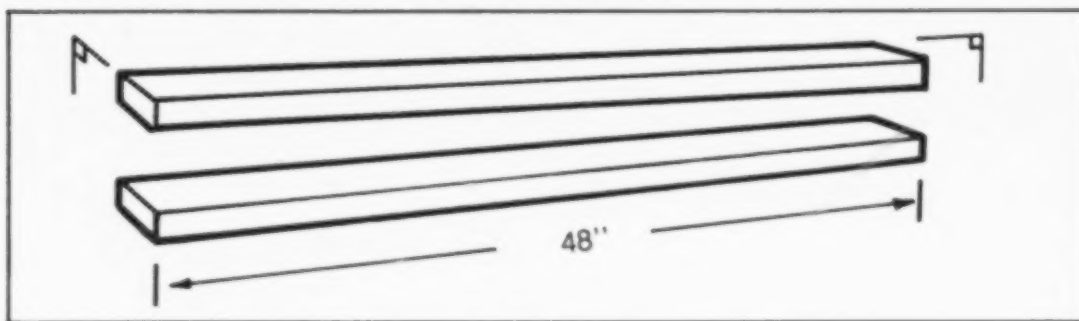


2"x4"x8", 1"x4"x50"

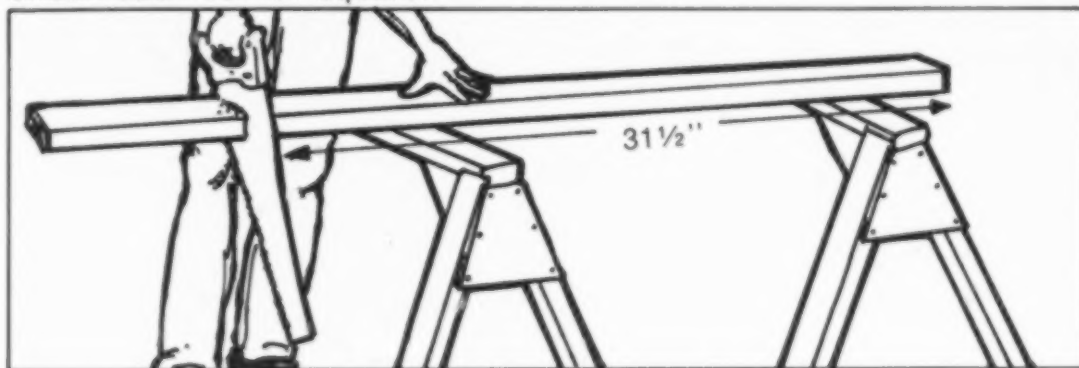
2. Square one end of each 2"x 4" stock.



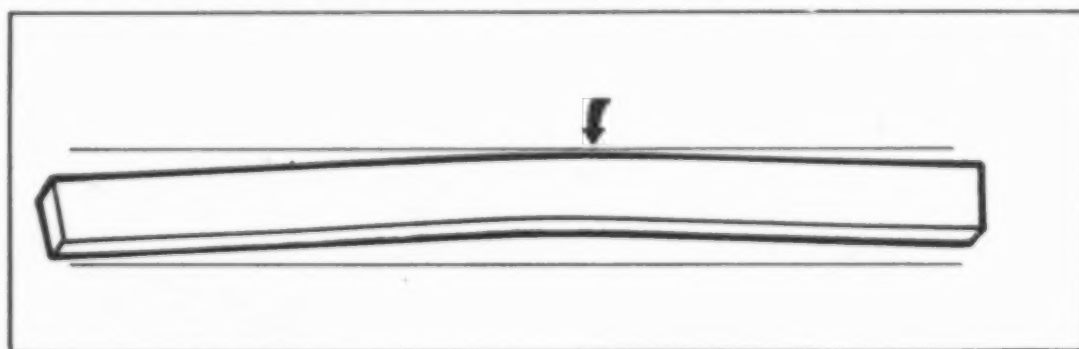
3. Layout and cut, one at a time, one top plate and one sole plate 2"x 4"x 48." Be sure to check cuts for square.



4. Layout and cut, one at a time, one top plate and one sole plate 2"x 4"x 44½." Check these cuts for square.
5. Layout and cut, one at a time, nine (9) studs 2"x 4"x 31½." Check each cut for square.

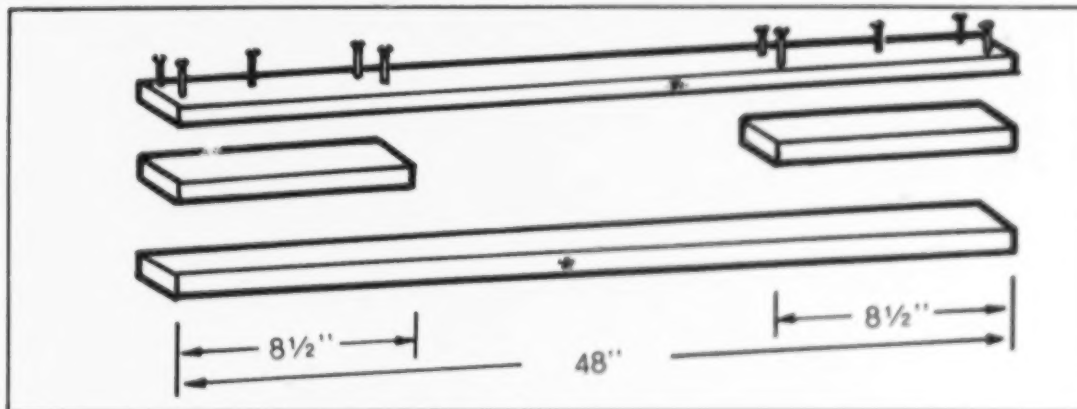


6. Check all plates and studs for crown and mark the high side.

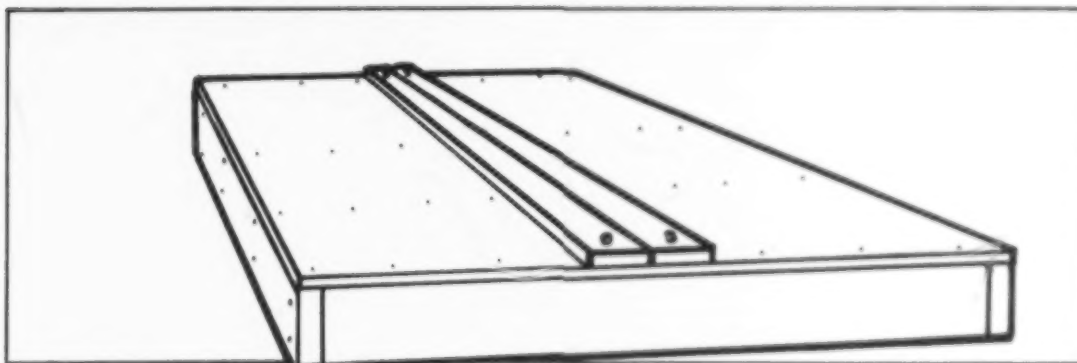


First Wall Section (4 Foot Section)

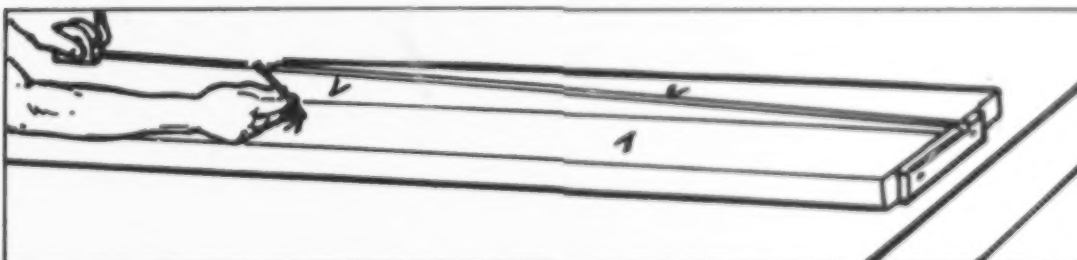
7. Layout and cut two corner blocks 2"x 4"x 8½" to be used for a three stud corner.
8. Keep all of the pieces square and flush with each other; carefully nail the two blocks between two studs. Use 16^d nails. Be sure the stud crowns are both on the same side.



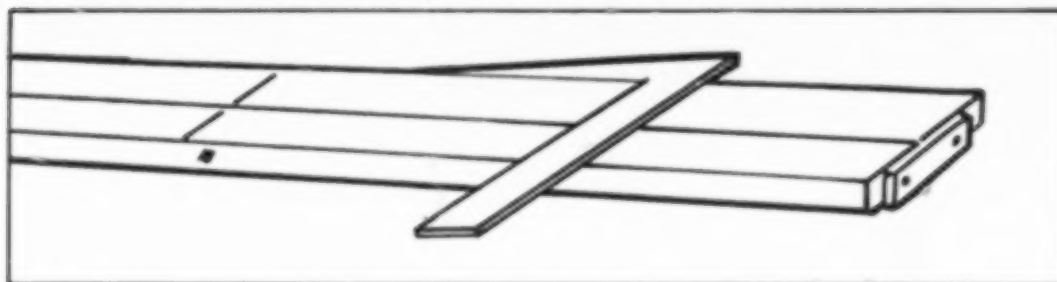
9. Tack the 48" top plate and sole plate edge to edge with the crowns out and ends flush onto the subfloor section. Use scaffold nails (two headed). Mark one end of each plate to keep them matched.



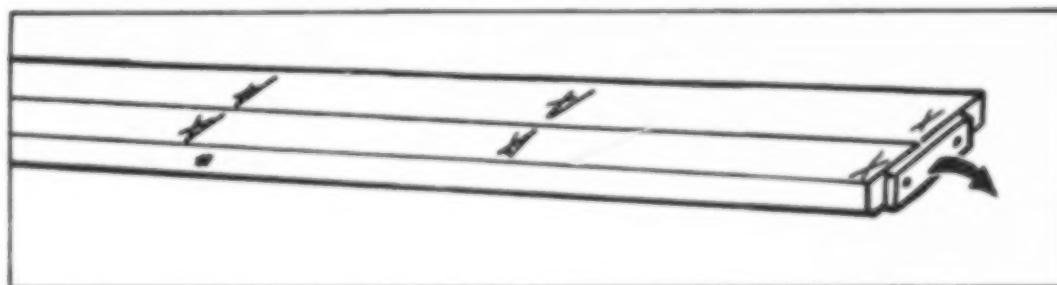
10. Using a tape measure and a ¾" scrap block, layout 16" centers on one plate.



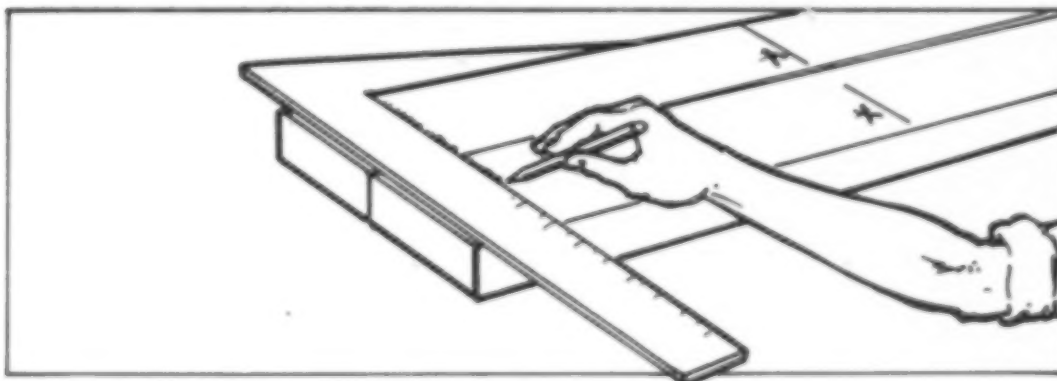
11. Use framing square and square across both plates.



12. Put an X on the side of the line opposite the $\frac{3}{4}$ " scrap block.
13. Put an X at each right end and remove the scrap block.



14. Flush the tongue of the framing square with the left end of the plates and draw a square line across both plates.



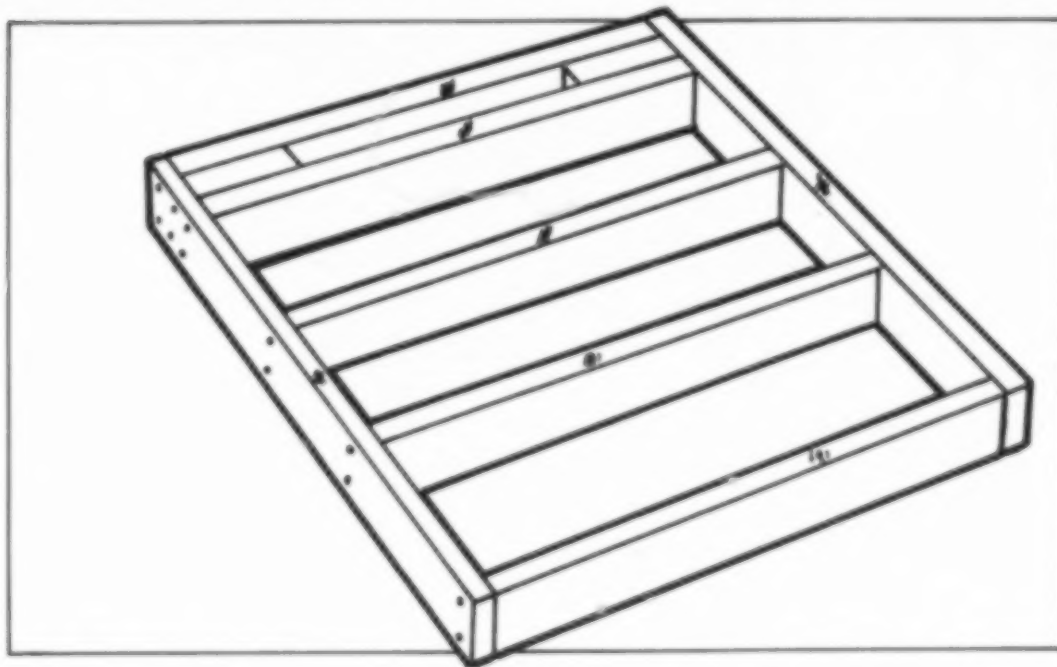
15. Move the square toward the right end with the top edge of the square tongue touching the line just made. Draw another square line against the bottom edge of the square tongue.



16. Move square again and draw a third square line next to the line just drawn.
17. Put X's next to these lines to mark corner studs and blocking.



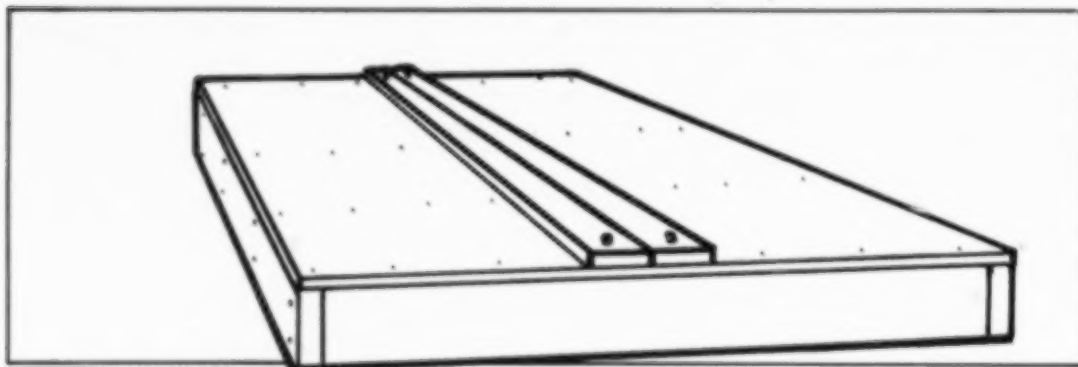
18. Remove the scaffold nails. Set the corner, the three studs, and the two plates on edge. Be sure all crowns are up.



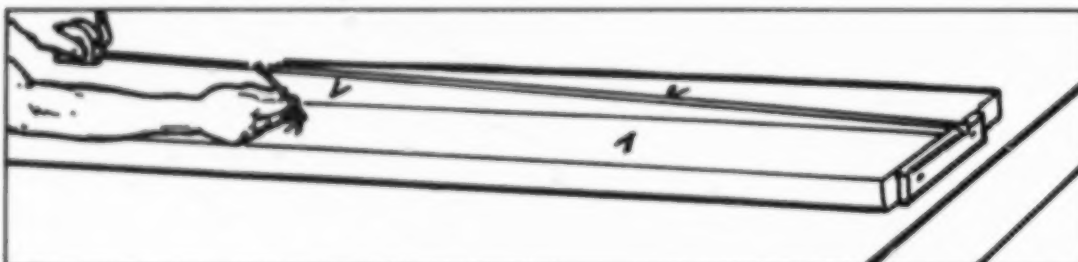
19. Nail wall section together using 16^d nails. Be sure studs are touching squared lines, cover the X's, and all members are flush.

Second Wall Section (44½" Section)

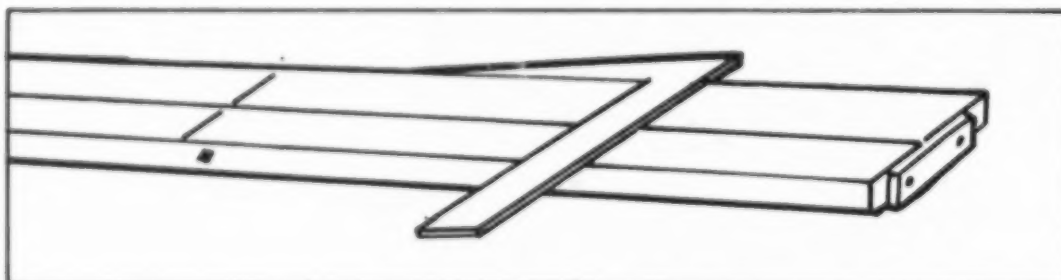
20. Tack the second wall section plates to the subfloor as you did with the first wall section. Mark the end that will go in the corner.



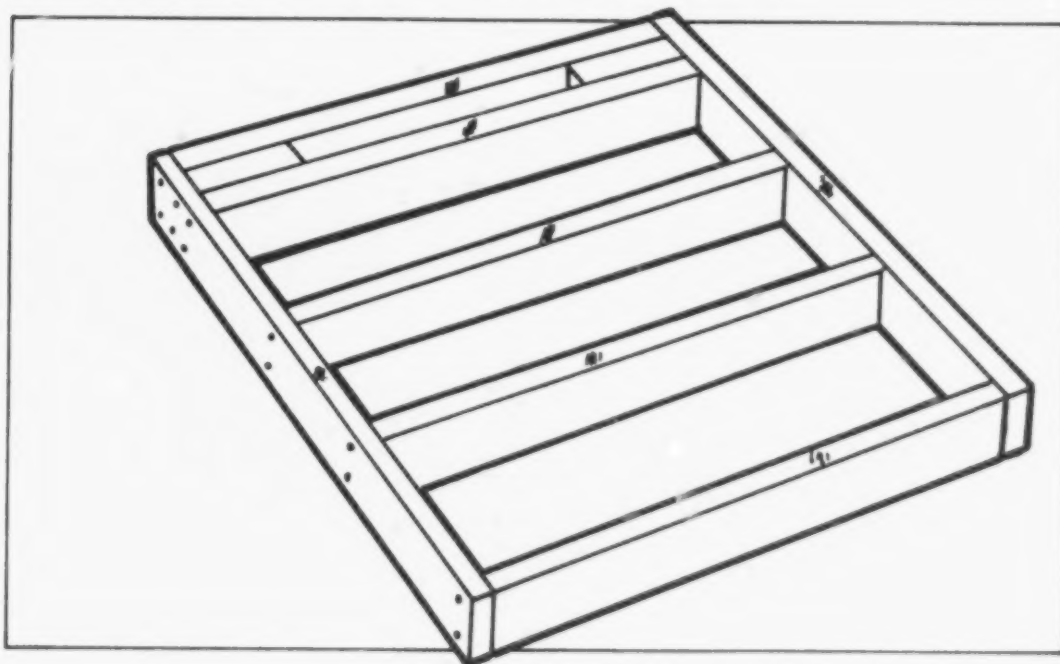
21. Use the scrap block and tape measure to layout 16" centers starting at the end opposite of the marked corner.



22. Use framing square to square across both plates. Add X's as you did earlier.

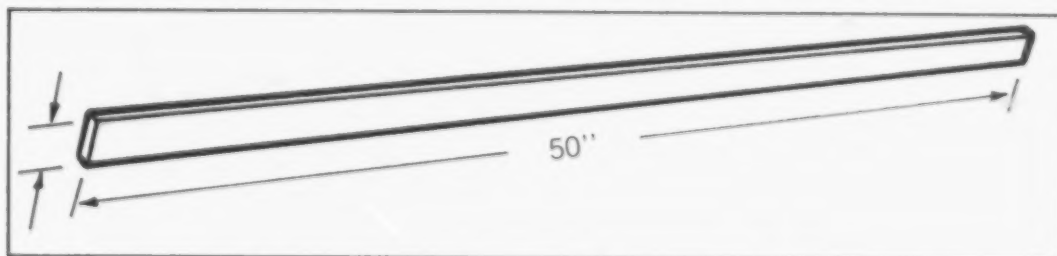


23. Remove scaffold nails and set the two plates and four studs on edge. Be sure all crowns are up.
24. Nail wall section together using 16^d nails. Be sure studs are touching squared lines, cover the X's, and are flush.

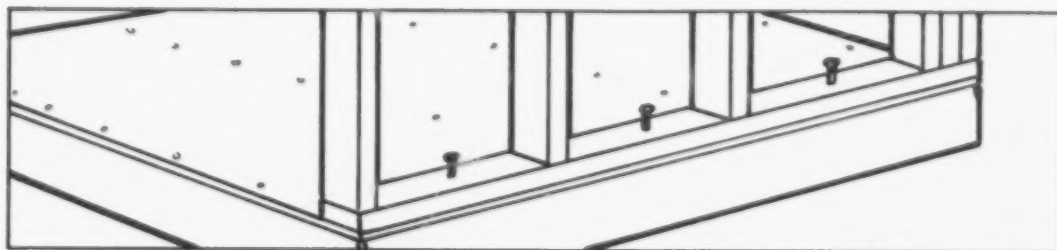


Connecting the Sections

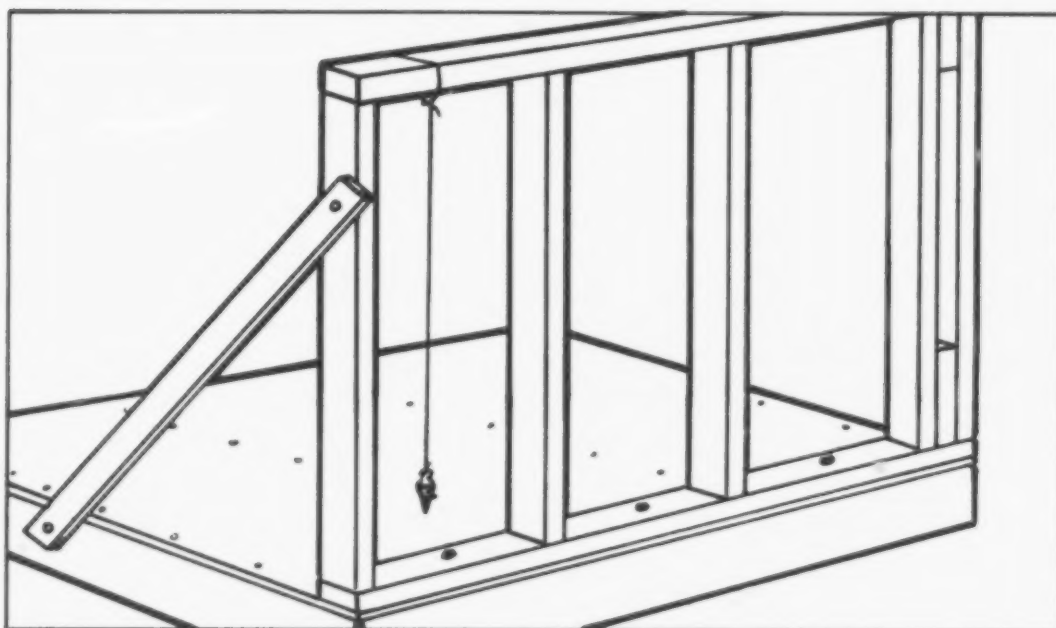
25. Cut a 1"x 4"x 50" brace to use as a temporary wall support.



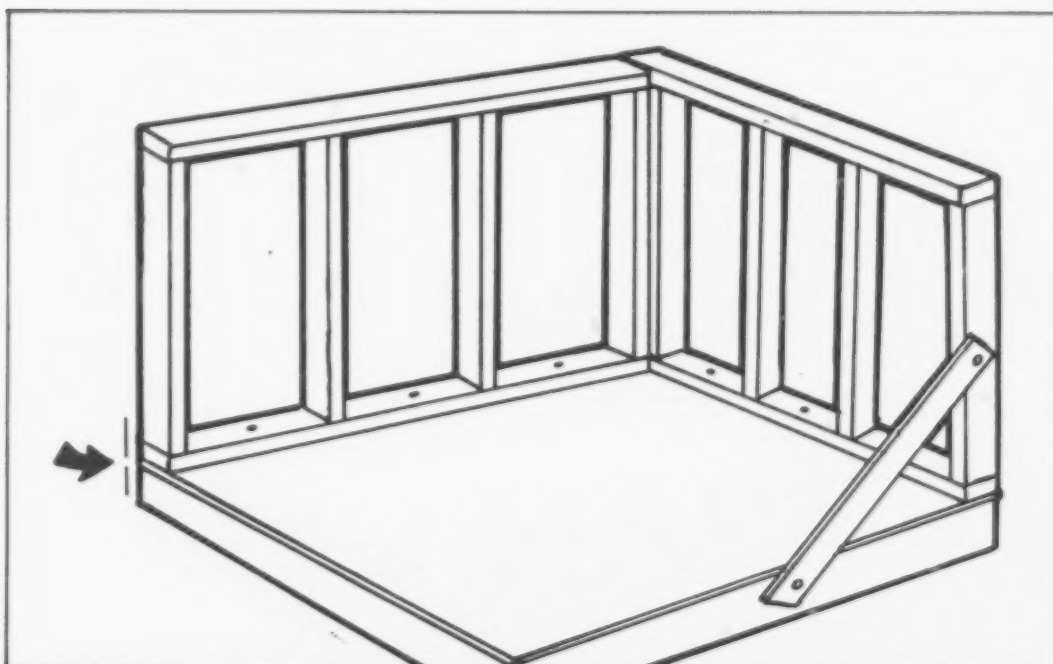
26. Nail the 4 foot wall section to the floor section. Use one 16^d nail between each stud. Be sure sole plate is flush with header joist and crowns are out.



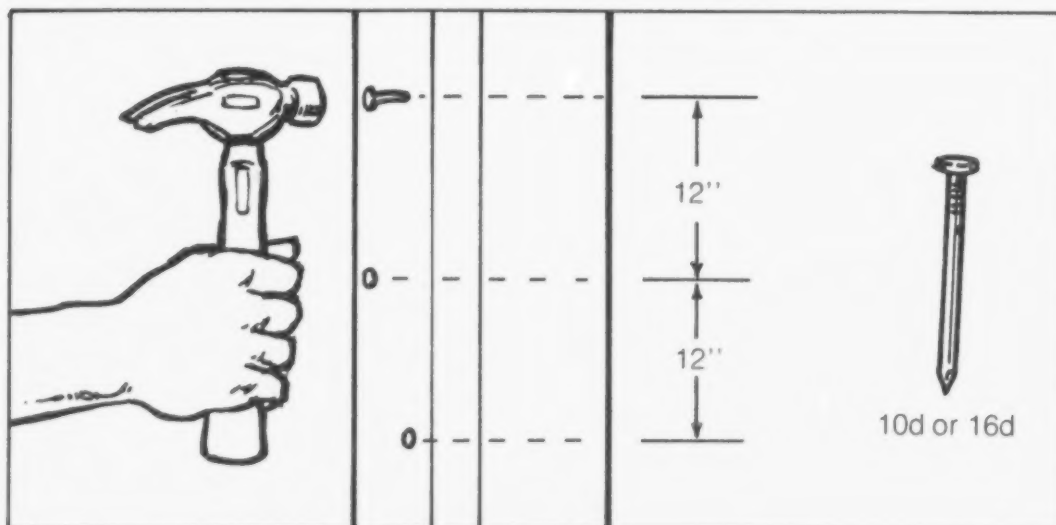
27. Using a scaffold nail, tack the 1"x 4"x 50" brace to the last stud on the 4 foot wall section.



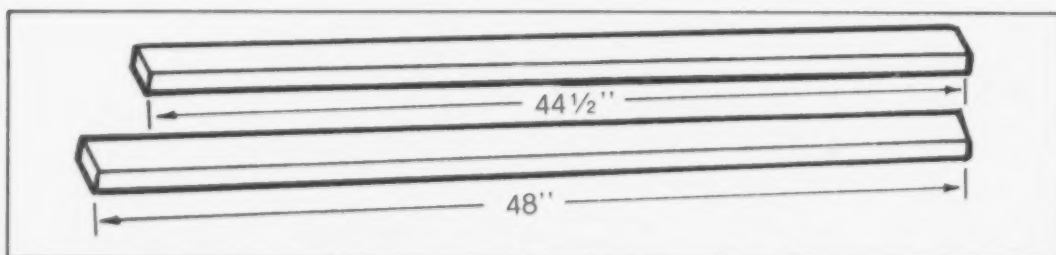
28. Use the level to plumb (straighten) the wall. Tack the other end of the brace to the end joist to hold the wall erect.
29. Nail the 44½" wall section to the floor. Be sure the end marked for the corner is touching the 4 foot wall corner. Use one 16^d nail between each stud. Be sure sole plate is flush to end joist.



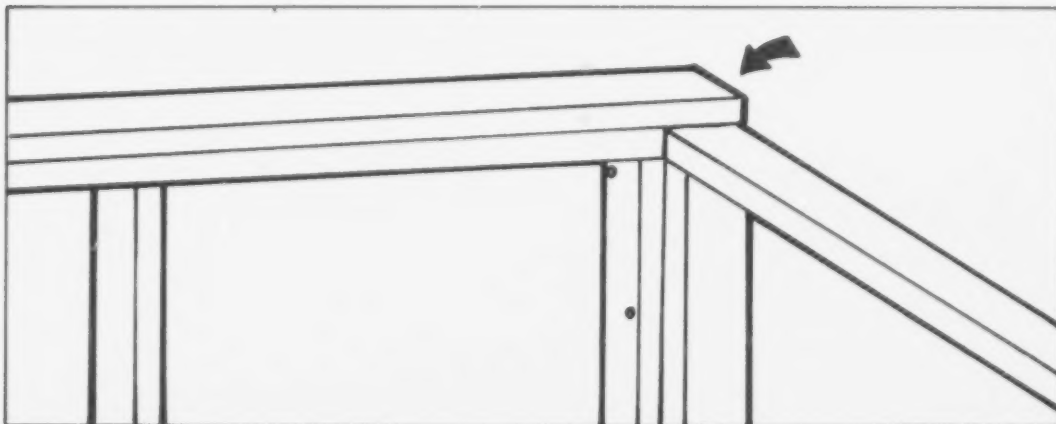
30. Nail through the short wall corner stud into the long wall's corner studs. Use 10^d or 16^d nails 12" apart. Stagger nails from side to side. Be sure walls are flush with each other.



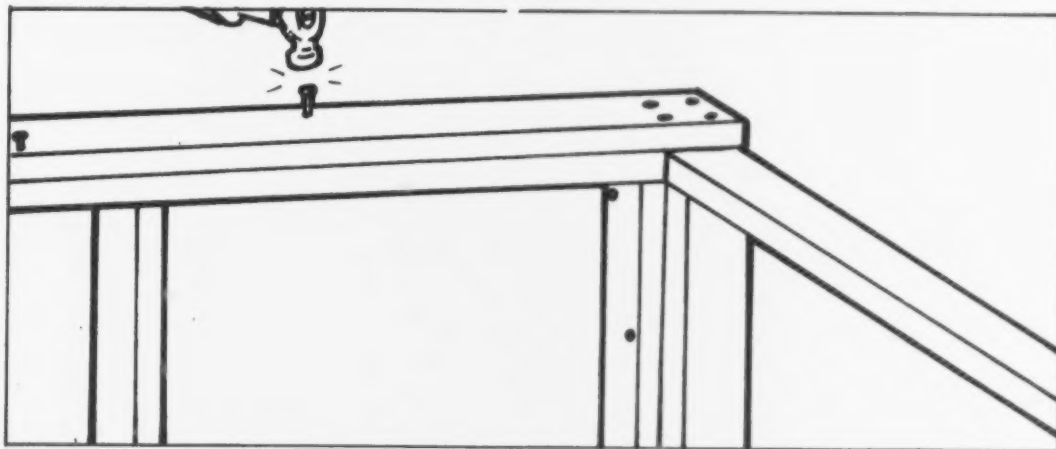
31. Layout and cut one 2"x 4"x 48" top plate and one 2"x 4"x 44½" top plate.



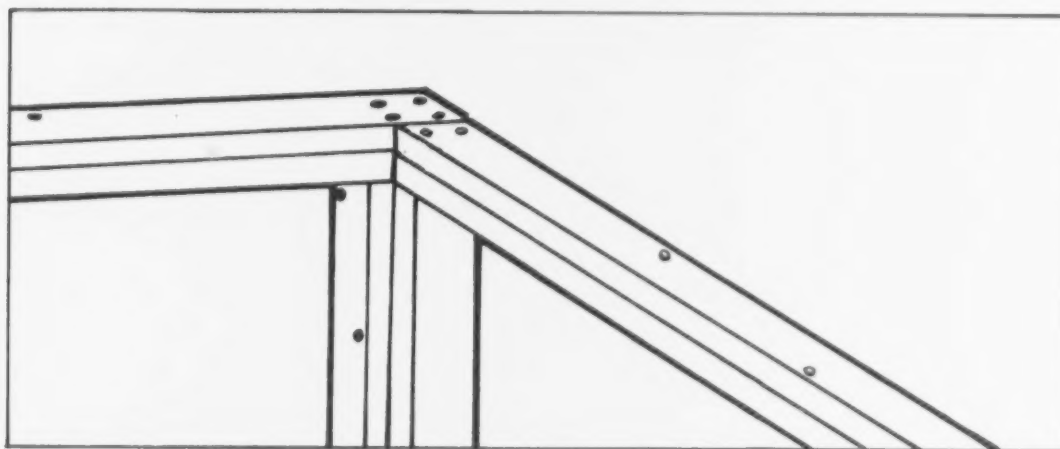
32. Lay the longer top plate so it is flush with the top plate of the short wall (44½") and laps over the top plate of the long wall (48").



33. Use 10^d or 16^d nails on 12" centers to nail this plate down. Stagger the nails. Use four nails in corner.



34. Nail other top plate to the top plate of the long wall section. Stagger nails and be sure to keep plates flush.

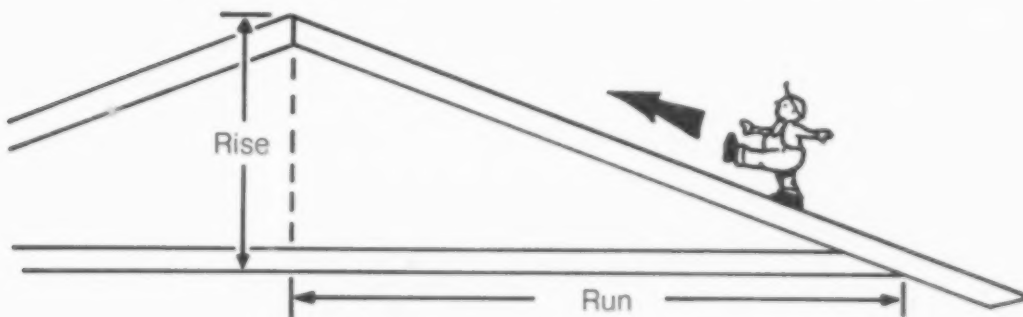


35. Remove diagonal brace. Have instructor check your work.

E. Figuring the Pitch of a Roof

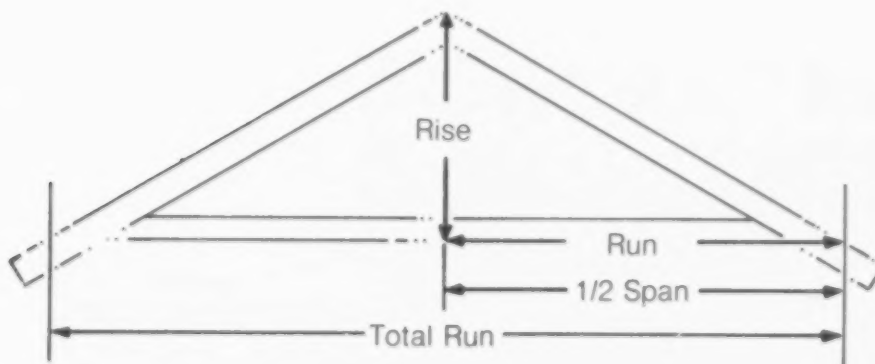
When doing roof framing, you will need to use your math skills to figure the length of rafters. To do this, you have to understand what slope or pitch means.

When you run up a slanted board (or roof), you are actually moving in two directions at once - forward and upward. In roof framing, the forward (horizontal) measurement is the run.



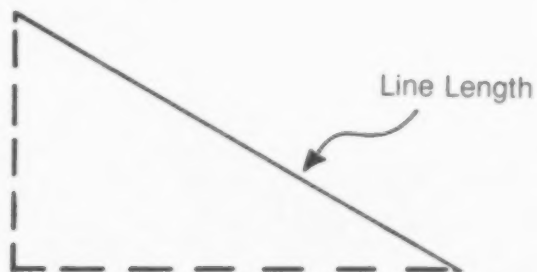
The upward (vertical) measurement is the rise.

The total run of a rafter is the horizontal distance which the rafter rises. Normally this is one-half of the span.

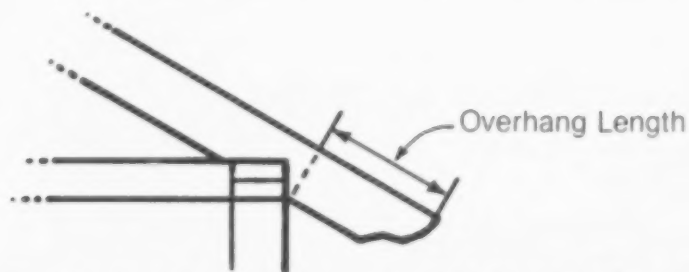


The total rise is the vertical distance which the rafter rises. Normally this is at the ridge of the roof.

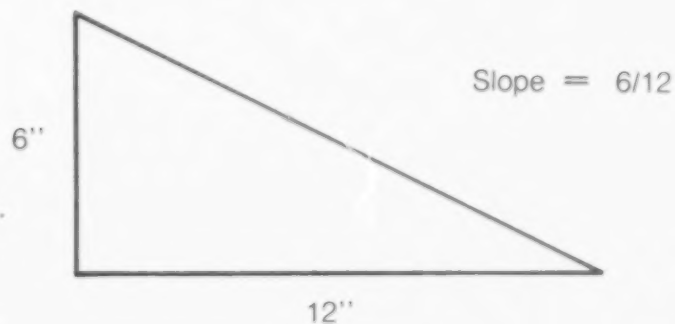
If you look at a drawing of this, it is the shape of a triangle. The rafter length (called line length) is the long side of this 90° triangle formed by the line length, the rise, and the run.



To find out how long your rafter needs to be, you use the rise over the run (pitch) to determine the line length. Pitch information that shows what rafter length to cut is usually listed in chart form on the framing square.



When cutting rafters, the overhang measurement is added to the line length taken from the chart to give the true rafter length.



Slope of a roof is often expressed in the number of inches of rise for every 12" of run. This classification of rise over run is called pitch. For example, 6-12 Pitch.

Figuring the Pitch of a Roof - Example

As you have seen, the pitch or slope of a roof is usually given as inches of rise for every 12" of run; and the length of a rafter can be computed by using the pitch and the chart found on the framing square. First you must find the pitch.

Example:

Find the pitch of a roof with an 8' total rise and 16' total run.

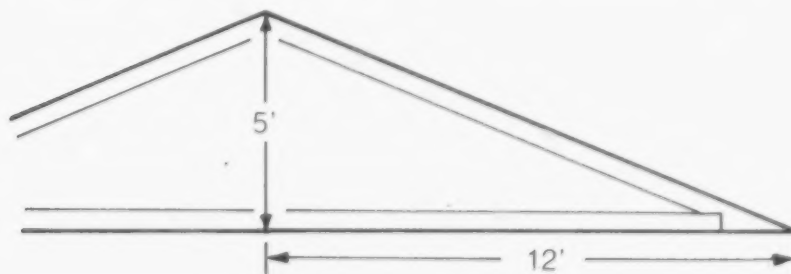
1. Multiply the total rise times 12 to give you the total rise in inches. $8' \times 12'' = 96''$
2. Next divide 96" by 16 feet. This gives you how many inches of rise there are for each foot (12 inches) of run.

$$\begin{array}{r} 6 \\ 16 \overline{) 96} \end{array}$$

So there are 6 inches of rise for every 12" of run or a 6/12 pitch.

Figuring the Pitch of a Roof - Problems

1. What is the Pitch of a roof that has 4 ft. of Total Rise and 12 ft. of Total Run?
2. What is the Pitch of a roof that has 4 ft. of Total Rise and 8 ft. of Total Run?
3. What is the Pitch of the roof in the illustration below?

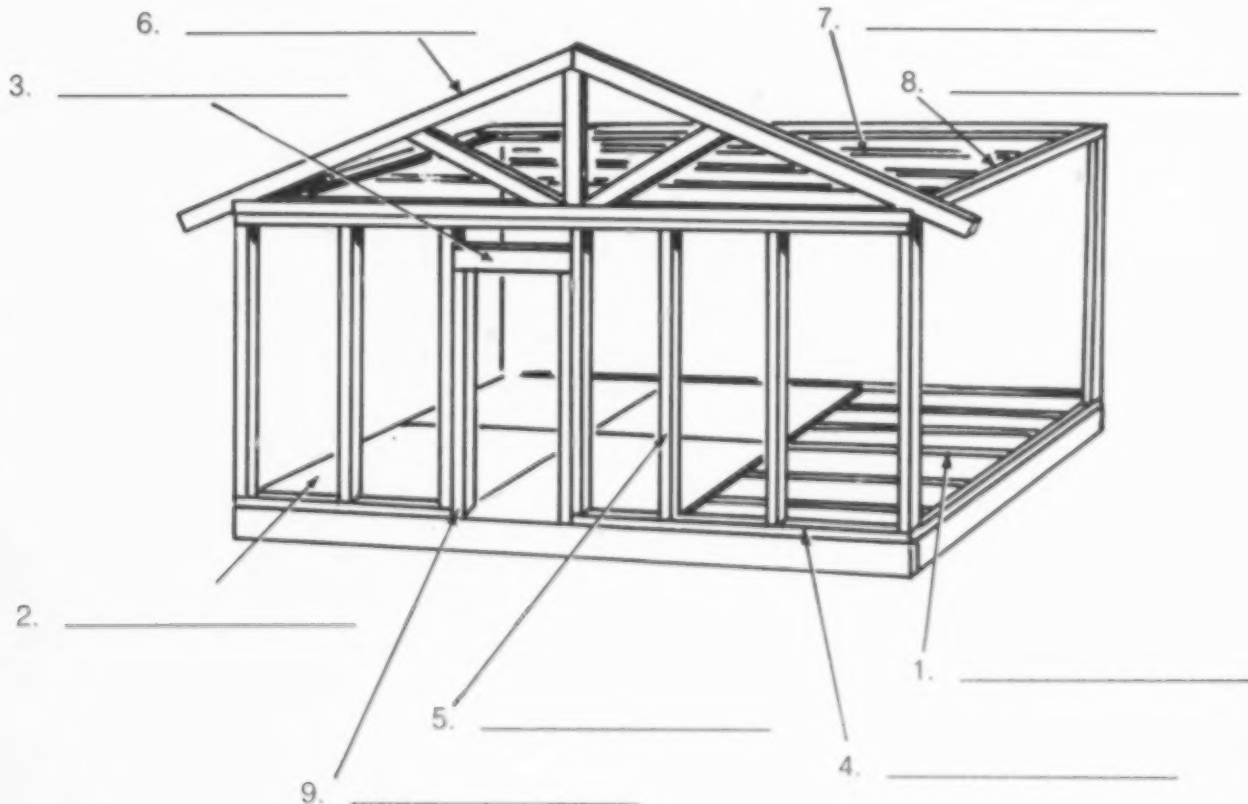


Framing

Unit Review

Directions: Identify the building frame members below by filling in the blanks. Use these words:

STUD FLOOR JOIST SUBFLOOR TRIMMER TOP PLATE RAFTER
SOLE PLATE HEADER CEILING JOIST



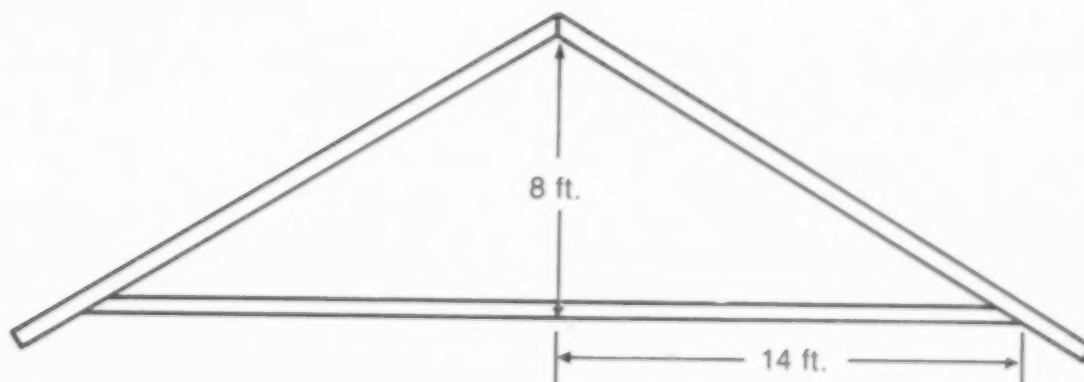
Directions: Put the following steps in their correct order of construction by putting numbers 1 through 7 in the blank lines.

- _____ A. Check joists and headers for squareness then mark crowns on each.
- _____ B. Layout and cut joists and headers with crowns up.
- _____ C. Mark off 16-inch centers on each header.
- _____ D. Nail end joists and floor joists to headers.
- _____ E. Check for squareness of constructed floor frame.
- _____ F. Chalk nail lines on subflooring and nail to floor frame
- _____ G. Measure and cut subflooring.

Directions: Put the following construction steps in their correct order by putting numbers 1 through 8 in the correct blank.

- _____ H. Layout and cut blocks and 2 x 4's for corner studs and wall studs for first wall section.
- _____ I. Plumb first upright wall section and tack brace on for support.
- _____ J. Properly fit and nail first wall section together.
- _____ K. Stand up second wall section and attach to floor section and first wall section.
- _____ L. Attach top plates for additional support.
- _____ M. Construct second wall section.
- _____ N. Stand up first wall section and nail sole plate to the floor section
- _____ O. Remove diagonal brace.

Directions: Find the pitch of the roof in the illustration below.



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Building Trades
Framing

Performance Checklist

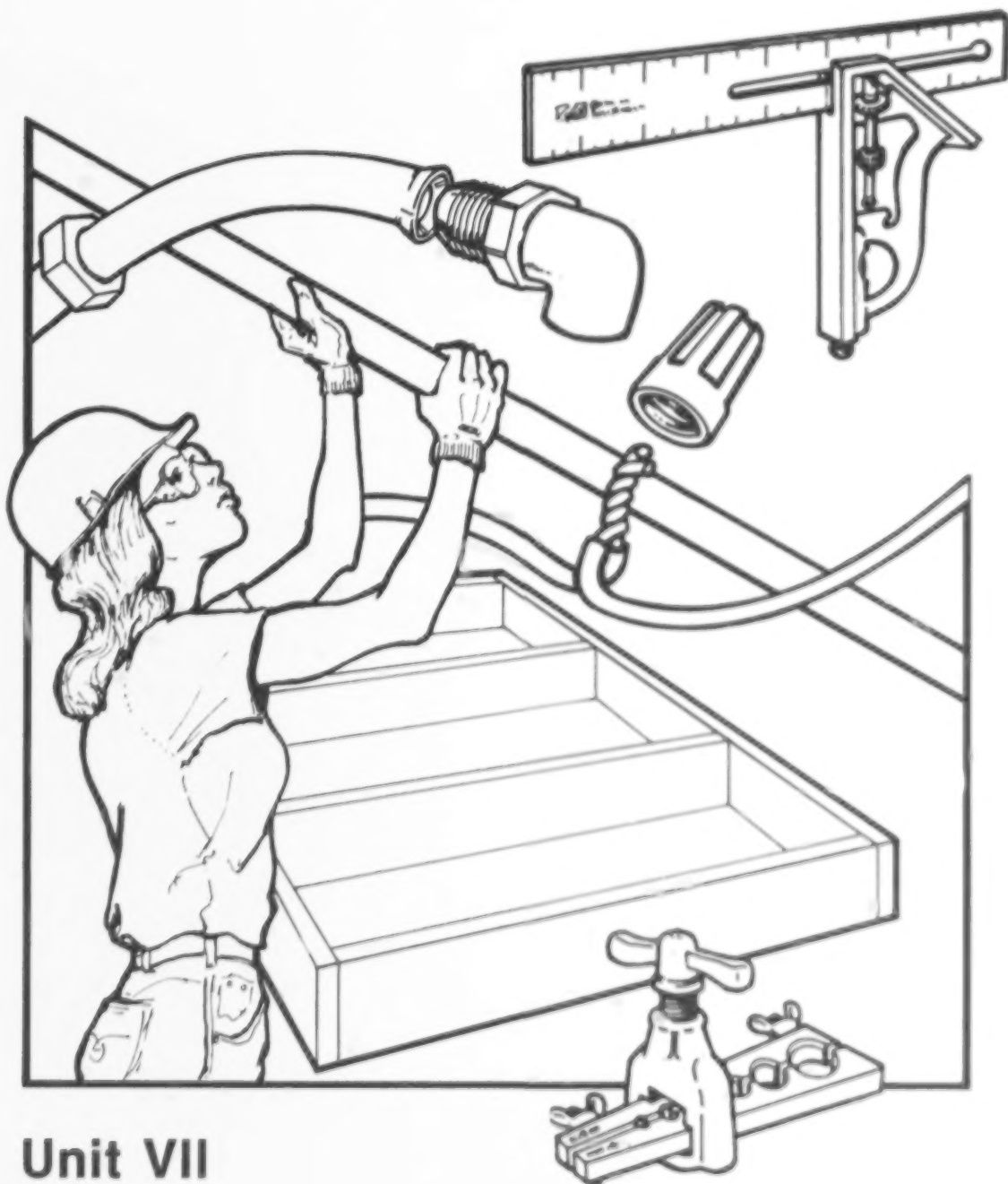
Student _____ has successfully performed the following steps of procedure.

Floor, Wall, and Roof Framing	Yes	No	Comments
1. Identified parts of floor framing			
2. Identified parts of wall framing			
3. Identified parts of roof framing			
Building a Section of Floor Framing			
1. Correctly assembled equipment and supplies for constructing floor framing			
2. Followed correct layout and construction procedure for building a floor frame			
Constructing Two Wall Sections			
1. Correctly assembled equipment and supplies for constructing wall framing			
2. Followed correct layout and construction procedure for building wall sections			
3. Connected two wall sections on floor frame correctly			
Figuring Pitch of a Roof			
1. Understood concepts of rise and run			
2. Correctly figured pitch of a roof			

Should Move On ☐
Repeat This Unit ☐

Student Signature/Date

Instructor Signature/Date



Unit VII

Roofing

Building Trades - Carpentry
Roofing

Applying Roofing Materials

After studying this unit, you will be able to:

1. Identify types of roofs and roofing materials.
2. Estimate the amount of roofing materials needed to cover a given area.

Check the Statement that Fits You Best

☐

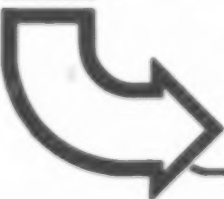
I can do these tasks and want to go through the Performance Checklist.



SEE YOUR INSTRUCTOR

☐

I want to study the information in this unit before I do the Performance Checklist.

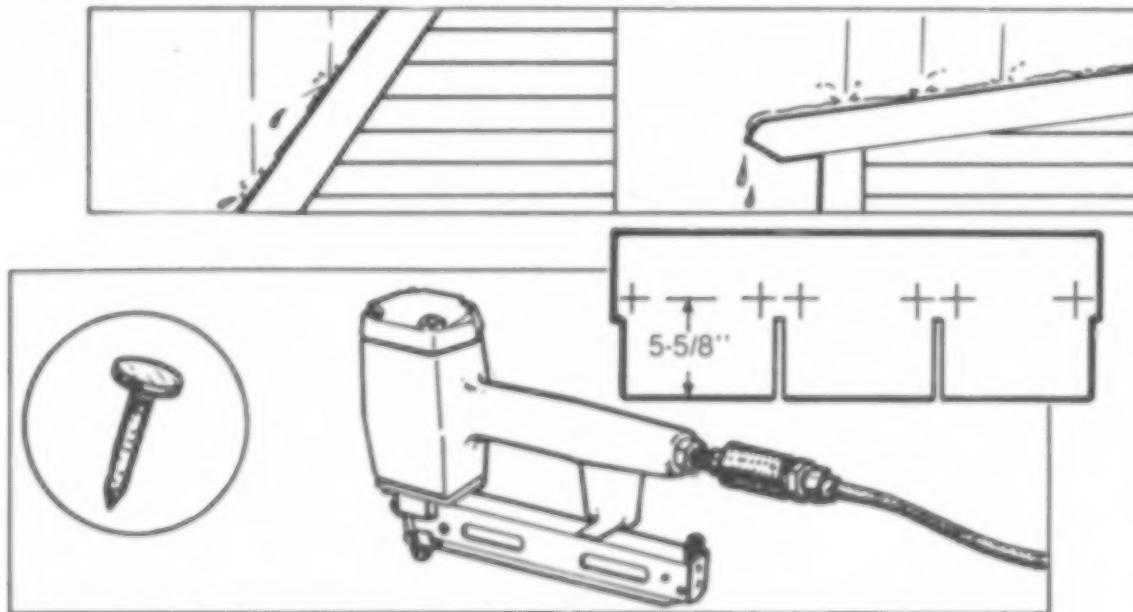


TURN PAGE AND BEGIN

Building Trades - Carpentry
Roofing

Introduction

A roof must protect the rest of a structure from rain, snow, and the sun. It should have a relatively long life (usually 20 years), be easy to maintain, and, in most cases, be attractive.



This unit will look at the flat roof and the pitched roof, which are the most common types of roof styles, as well as examining some of the more common roofing materials used to cover a roof.

TURN TO NEXT PAGE

Building Trades - Carpentry
Roofing

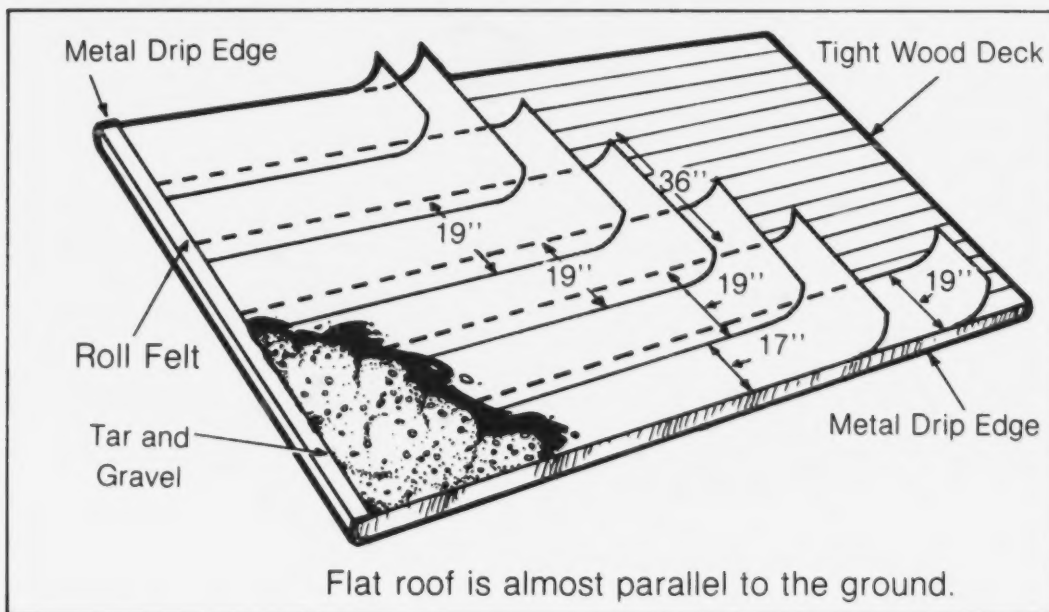
A. Terms and Equipment

1. Bundle - A number of asphalt shingles (26 or 27) wrapped together to ease handling and stacking (Each bundle is $\frac{1}{3}$ of a square.)
2. Pitched - Sloped or slanted downward
3. Square - A term in roofing used to signify that a product will cover a 10' x 10' square or 100 square feet
4. Galvanized broadhead roofing nail - A short nail with a flat head coated with zinc to prevent rusting
5. Air Nailer - A machine used to drive roofing nails when attaching asphalt shingles to a roof
6. Roll felt - Material made of fiber and asphalt which is spread over a roof before the shingles are nailed on

Roofing

B. Common Roofs and Roofing Materials

As mentioned, there are two styles of roofs most commonly used on structures - the flat roof and the pitched roof. A flat roof is designed so that water runs off the edges. In real life, however, a flat roof is never perfectly flat and often large puddles of water stand on the roof for long periods of time. To protect against standing water, flat roofs are either covered with roll felt overlaid with tar and gravel, or a synthetic elastic roofing is used.

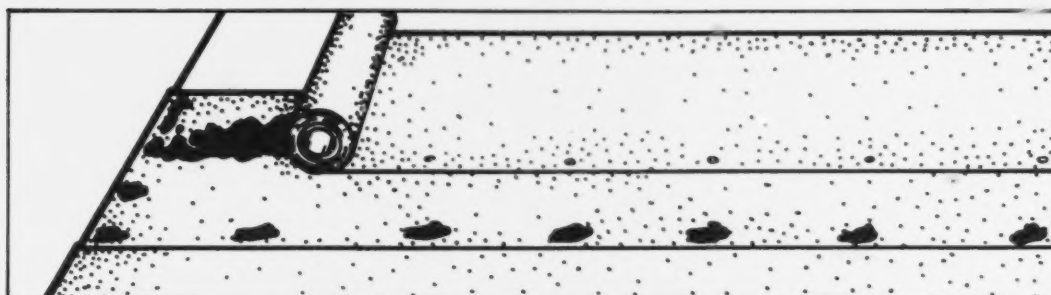


Pitched Roof

Because gravity helps water to run off of a pitched roof, shingles don't have to be absolutely water-tight like they are on a flat roof. However, the less pitch a roof has, the slower the water runs off of it, and the more chance the water has to find a leak and run into the house.

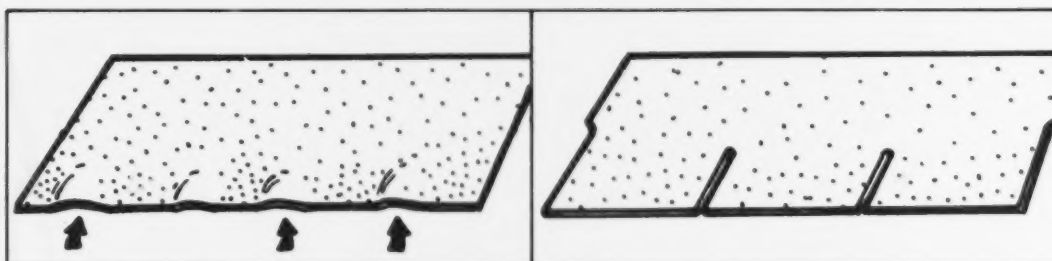


To avoid these leaks, pitched roofs with a shallow pitch often have roll roofing instead of shingles because the roll roofing can be more waterproof at low angles.

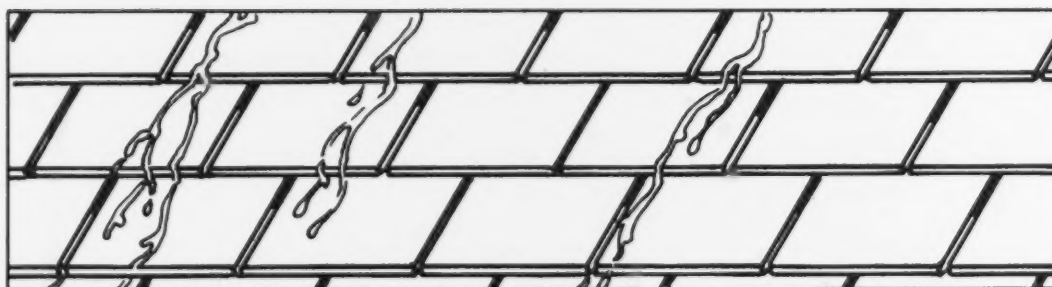


On steeper pitched roofs, asphalt shingles, wood shingles, plastic shingles, slate, clay tile, fiberglass, or metal, can be used. Asphalt and fiberglass shingles are the most commonly used.

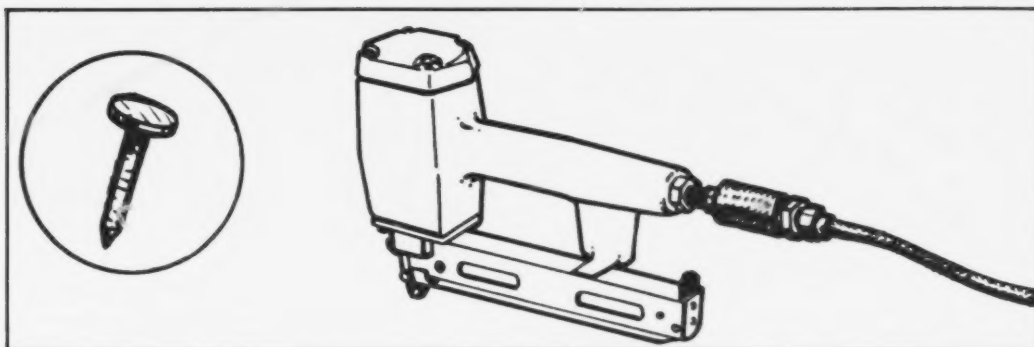
Asphalt and fiberglass shingles are approximately 36 inches long. If they were solid, they would ripple when the sun shines on them. To prevent this and to allow the roof to lay flat, each shingle has slots cut into it.



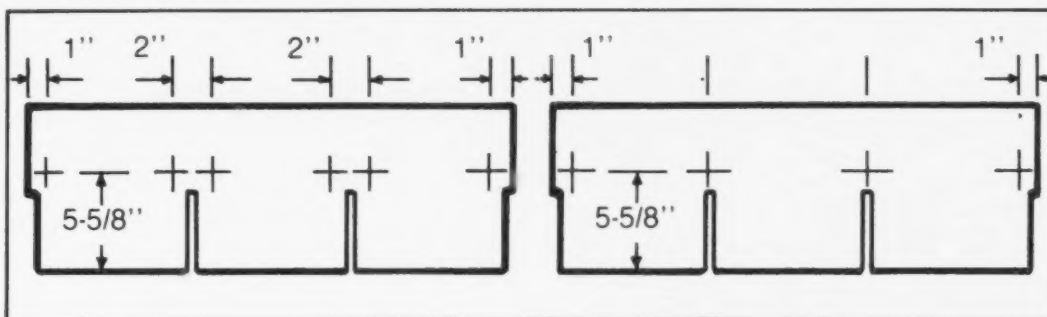
Shingles are overlapped so water runs off of the top shingle onto the one below it. Shingles are staggered so that the edges of the top shingle fall onto the solid surface of the shingle below it.



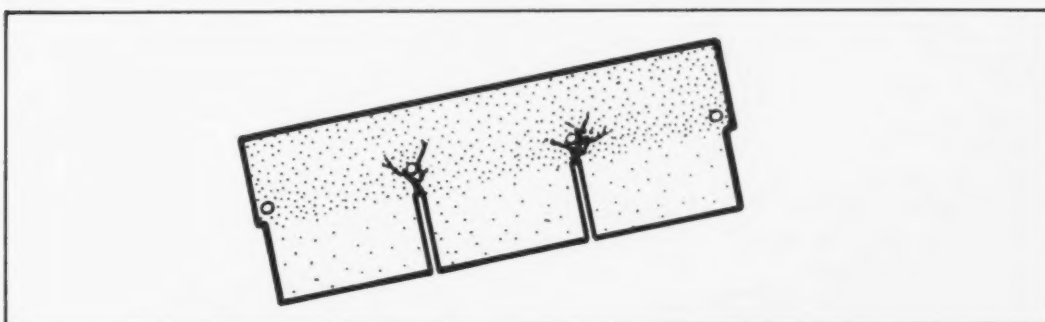
Shingles are usually nailed to the roof decking with a galvanized broadhead roofing nail. These nails are either driven by hand or by pneumatic powered nailer.



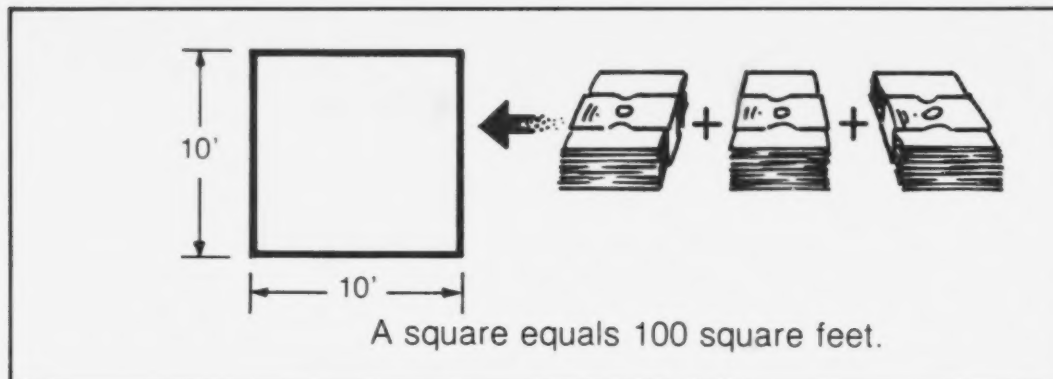
Shingle manufactures suggest using a six-nail per shingle pattern, but most roofers use a four-nail per shingle pattern.



A four-nail per shingle pattern saves time and nails, but it also causes tearing and cracking at shingle slots which gives the roof a shorter life span.



Roofing materials are estimated and sold in a unit called a square. A square is a 10 ft. x 10 ft. area which equals 100 square feet.



Shingles are usually sold by bundles. Bundle size is determined by weight. Because a square of shingles is too heavy for a person to carry, a square is usually divided into three bundles.

Roofing

C. Estimating Roofing Materials

A square equals 100 square feet. This could be any rectangle whose area is equal to 100 square feet. However, a square 10 feet by 10 feet equalling 100 square feet is where the building trades term came from.

When estimating roofing material you are trying to figure how many 100 ft. squares you need to cover the roof.

1. Calculate the number of squares needed to cover one side of the roof by multiplying the length of one side times the width of the side and dividing by 100.

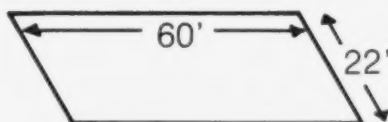
$$\frac{\text{Length of Side of Roof} \times \text{Width of Side of Roof}}{100} = \text{Number of Squares per Side}$$

2. Multiply the number of squares on one side by two to get the total number of squares for the roof.

$$\text{Squares per side} \times 2 = \text{Squares for the Roof}$$

3. Calculate the number of squares needed to cover the ridge. Usually you can figure roughly 17 to 20 linear feet of coverage per bundle. Therefore, divide the length of the ridge by 20 to get the number of extra bundles needed. Then divide the number of bundles by three to get the number of squares.

Example:



$$60/20 = 3$$

$$3/3 = 1 \text{ square for the ridge}$$

Roofing

Skill Sheet 1 Estimating Roofing Materials

Directions: Determine how much roofing material is needed in each of the following problems.

1. One side of a roof is 22' x 50'. How many squares are needed to cover the flat part of the roof?
2. One side of a roof is 20' x 70'. How many squares are needed to cover the flat part of the roof?
3. One side of a roof is 25' x 60'. How many squares are needed? (This time include the ridge too.)

Roofing

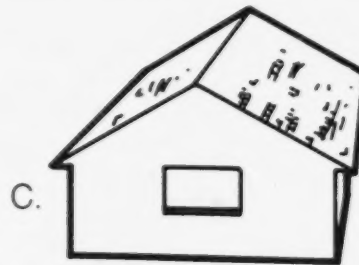
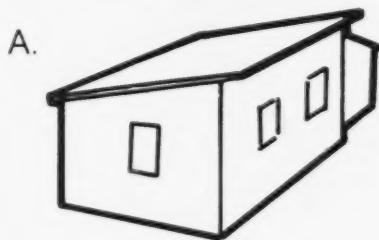
Unit Review

Directions: Match each word with its definition by writing the correct letter in each blank.

- | | |
|-----------------------|---|
| ___ 1. Bundle | A. A sloping roof |
| ___ 2. Square | B. A roof with no slope |
| ___ 3. Pitched Roof | C. Pieces of fiberglass or asphalt used to cover a roof |
| ___ 4. Flat Roof | D. Amount of shingles covering 100 square feet |
| ___ 5. Shingles | E. Amount of shingles in 1/3 of a square |
| ___ 6. Roll Felt | F. Materials placed on top of roll felt on flat roofs |
| ___ 7. Tar and Gravel | G. Layer of roofing material applied under the shingles |

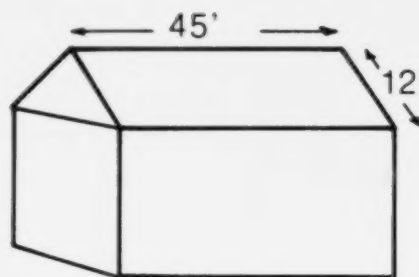
Directions: Match each picture with its name by writing the correct letter in each blank.

- ___ 8. Broadhead Galvanized Nail
 ___ 9. Shingle
 ___ 10. Flat Roof
 ___ 11. Pitched Roof



Answer each problem in the space provided. SHOW YOUR WORK.

12. How many squares will be needed to cover the entire roof of this house (including the ridge)?



13. One side of a roof measures $24' \times 35'$. How many squares will be needed to cover the entire roof (including the ridge)?

Building Trades - Carpentry
Roofing

Performance Checklist

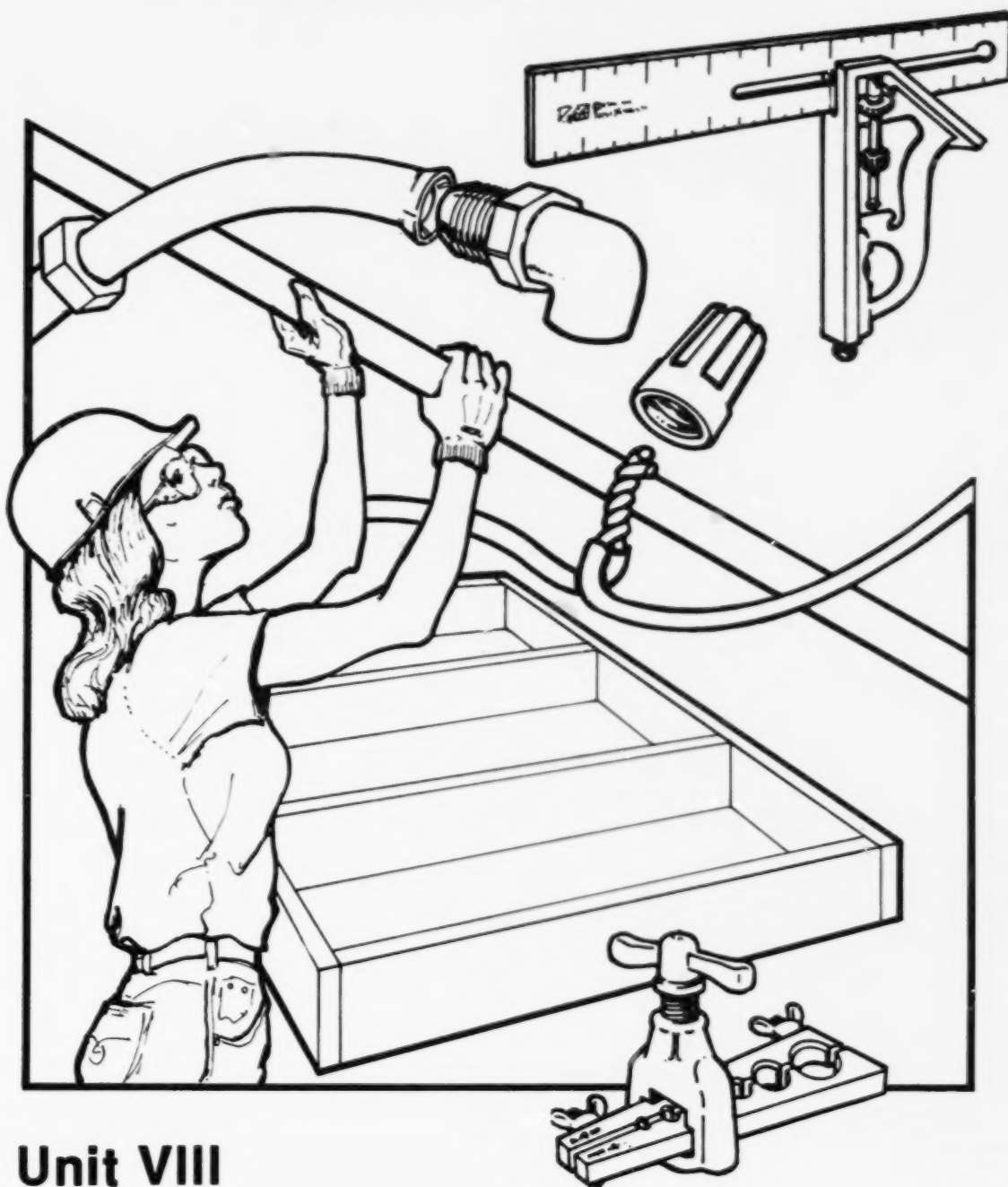
Student _____ has successfully performed the following steps of procedure.

Identifying roof types and roofing materials	Yes	No	Comments
1. Identified types of roofs			
2. Identified common types of roofing materials			
Estimating roofing materials	Yes	No	Comments
1. Calculated number of squares needed to cover sides of roof			
2. Calculated number of squares needed to cover ridge			
3. Calculated total number of squares needed to cover a roof			

Should Move On ☐
Repeat This Unit ☐

Student's Signature/Date

Instructor's Signature/Date



Unit VIII

Installing Drywall

Building Trades - Carpentry
Installing Drywall

Installing Drywall

After studying this unit, you will be able to:

1. Identify tools and materials necessary to install sheetrock.
2. Cut and hang sheetrock.
3. Apply joint tape and compound.
4. Calculate amount of drywall needed to cover a given area.

Check the Statement that Fits You Best

☐

I can do these tasks and want to go through the Performance Checklist.



SEE YOUR INSTRUCTOR

☐

I want to study the information in this unit before I do the Performance Checklist.



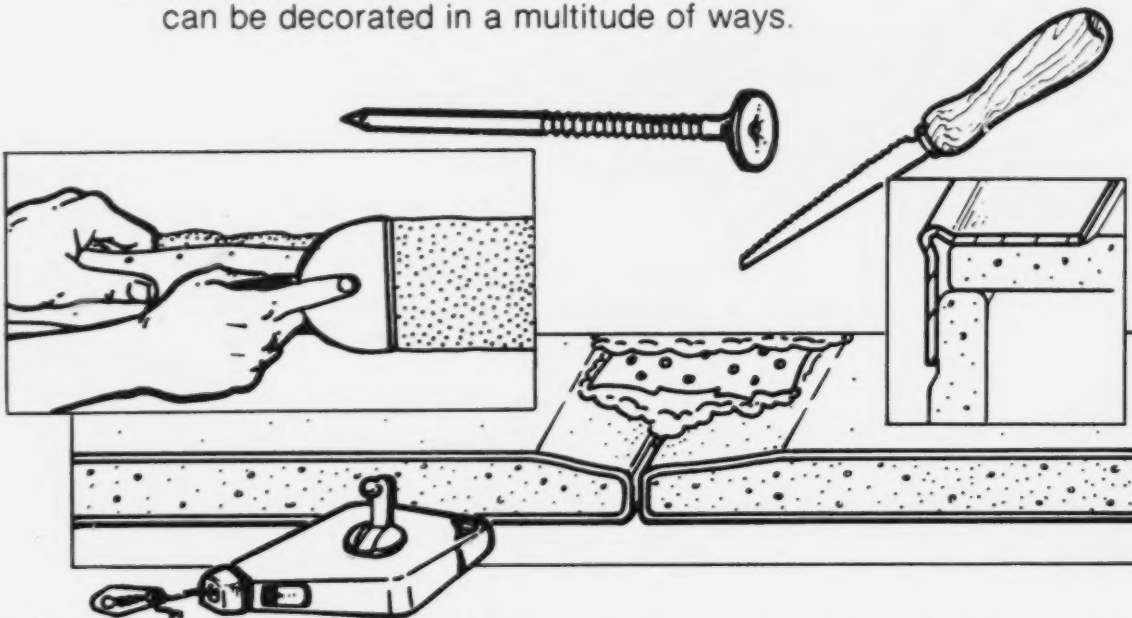
TURN PAGE AND BEGIN

Building Trades - Carpentry
Installing Drywall

Introduction

Drywall (also known as sheetrock) is the most commonly used interior wall construction in the United States today. This material is used so much because it:

- makes a high quality wall,
- is readily available,
- can be fire or water resistant,
- is easily hung or repaired,
- has a relatively low cost,
- can be decorated in a multitude of ways.



In this unit, you will learn to identify the tools and materials used in installing drywall, the steps for installing sheetrock on walls and ceilings and how to prepare it for painting.

TURN TO NEXT PAGE

Building Trades - Carpentry
Installing Drywall

A. Terms and Definitions

1. Drywall - Usually refers to a gypsum core board with a sheet of paper on either side (Drywall is often called sheetrock, plaster board, or gypsum board)
2. Hang, Hanging - To hang drywall means to permanently fasten it to its supporting structure (studs, joists, etc.)
3. Joint Knife - Large springsteel putty knife used for applying joint compound
4. Mud - The joint compound used with drywall tape to fill and blend joints, nail dimples, and defects in the sheetrock

Building Trades - Carpentry

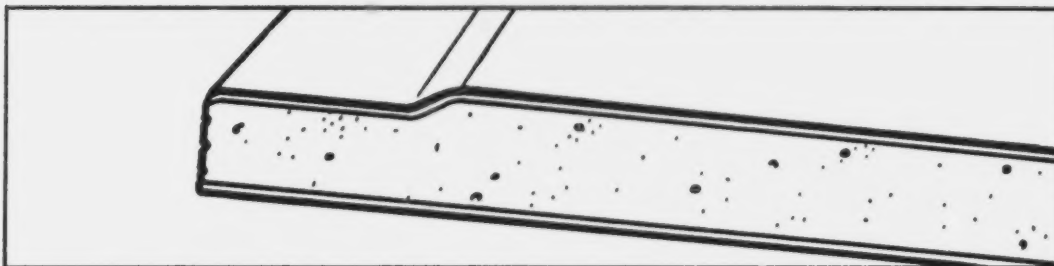
Installing Drywall

B. Installing Drywall

A mixture of water and plaster is used when plastering interior walls and ceilings.



Even though wall coverings such as wood planking and paneling are technically called drywall, the term generally refers to gypsum board (also called plaster board, wall board, or sheet rock).

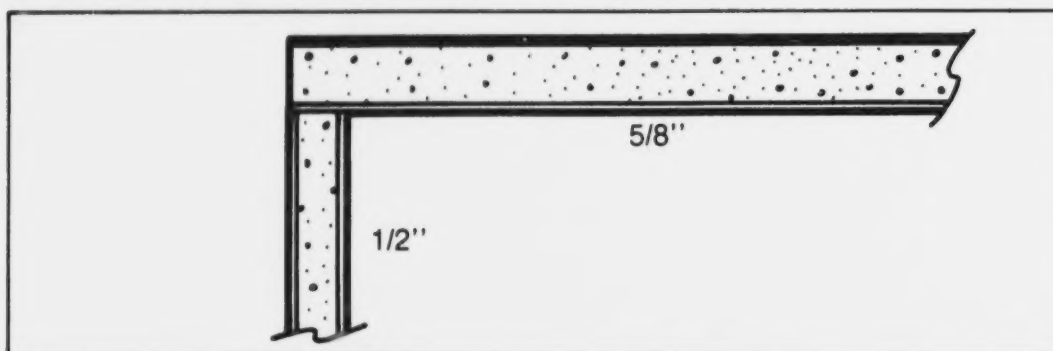


The term drywall is used because it takes little or no water to "hang" sheet rock.

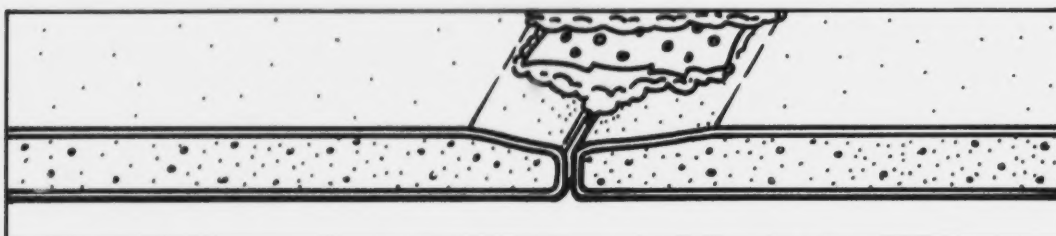
The three main types of drywall are:

1. Regular Gypsum Board - has general use on walls and ceilings
2. Type X (also called Fire Code) - more fire resistant than regular board (It is used in places like fire walls or commercial kitchens.)
3. Water Resistant - has water resistant paper and core (It is used in wet areas like bathrooms and laundry rooms.)

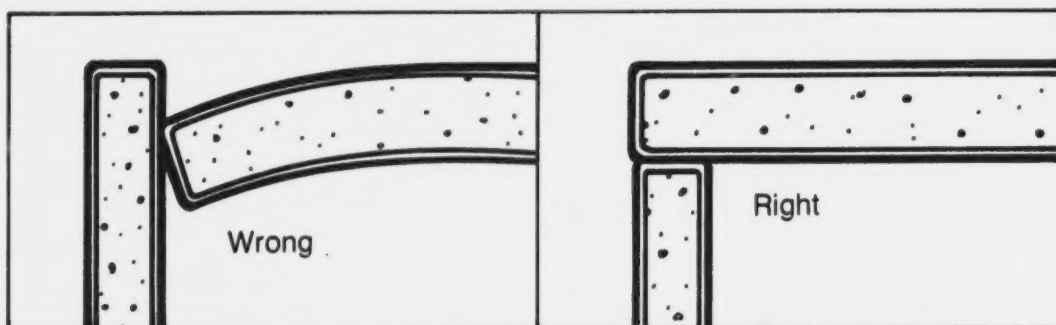
Drywall comes in several thicknesses (1/4", 3/8", 1/2", 5/8", and 1"). The two most commonly used thicknesses are 1/2" and 5/8". 1/2" sheetrock is used for single-layer walls while 5/8" sheetrock is used for single-layer ceilings.



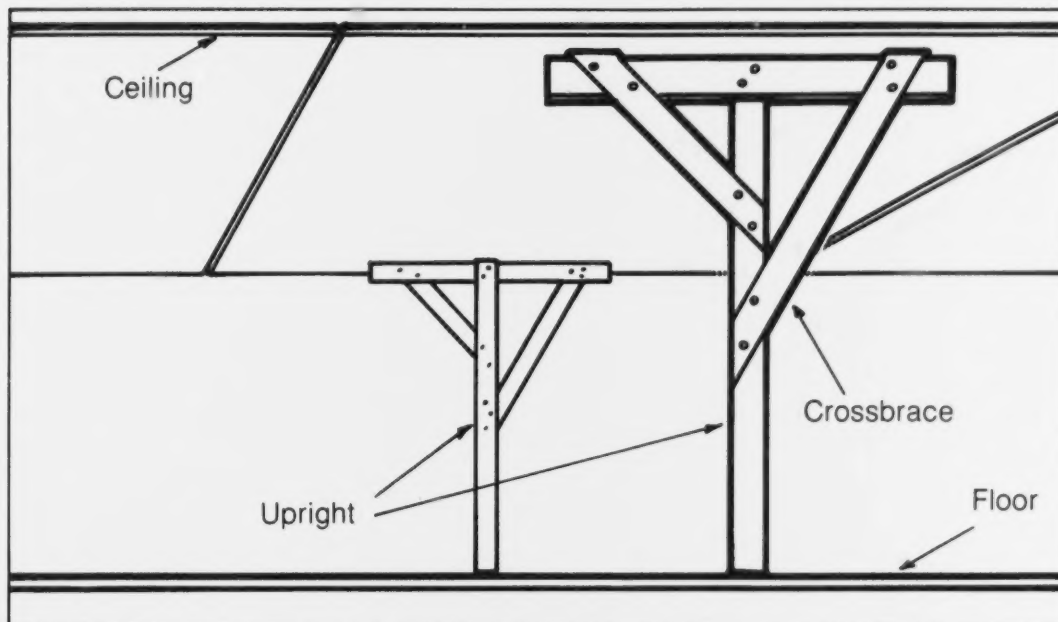
The edges of sheet rock are often tapered. This allows the joints to be "mudded and taped" and still end up flush with the main surface of the sheetrock.



When hanging sheetrock, the ceiling is done first. This allows the sheetrock on the walls to support the edges of the ceiling sheetrock.

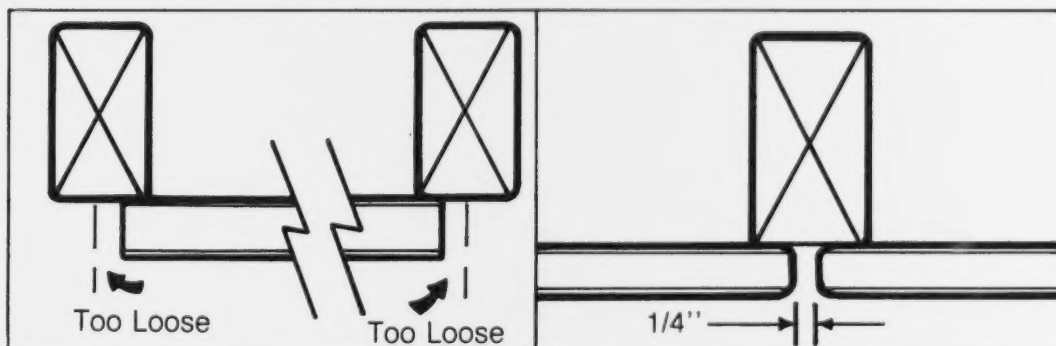


Often a 'deadman' is used to hang ceiling sheetrock. A deadman is a T-shaped brace that helps hold the rock tightly in place while it is nailed.



Sheetrock joints should fit close but not tight. 1/4" space is adequate. Too tight a fit will often damage the rock when it is hung and can cause problems when mudding the joints.

If it is too loosely cut, the edges will not reach from the center of one stud to the center of the other stud. Proper hanging will be impossible without extra materials and effort.



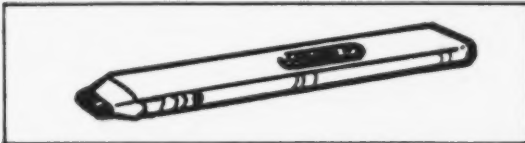
Building Trades - Carpentry

Installing Drywall

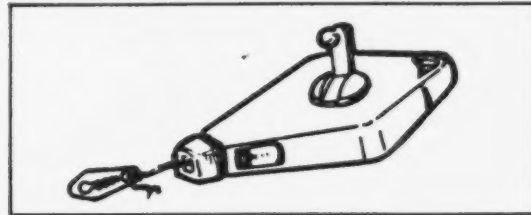
C. Cutting and Hanging Sheet Rock

1. When cutting sheet rock you need a tape measure, pencil, chalk line, straightedge, sheetrock saw, and a utility knife.

Pencil



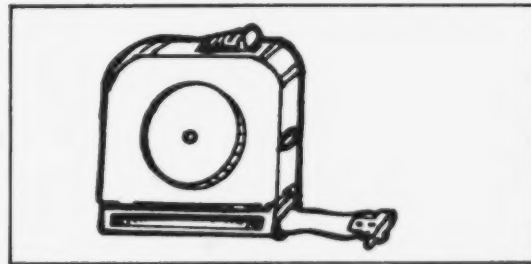
Chalk Line



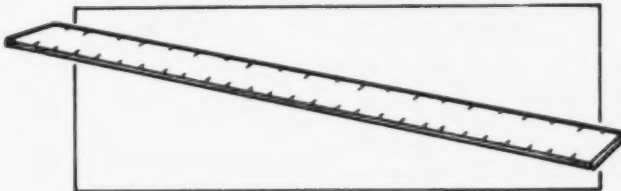
Sheetrock Saw



Tape Measure



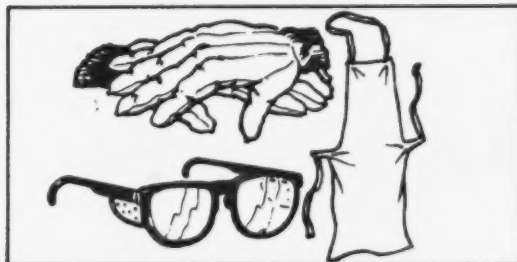
Straightedge



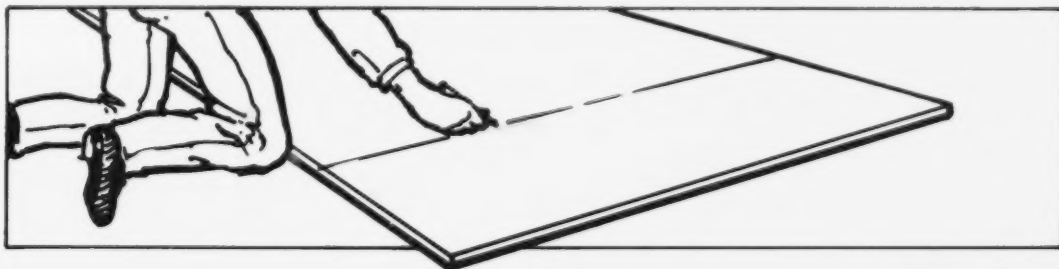
Utility Knife



Safety Equipment



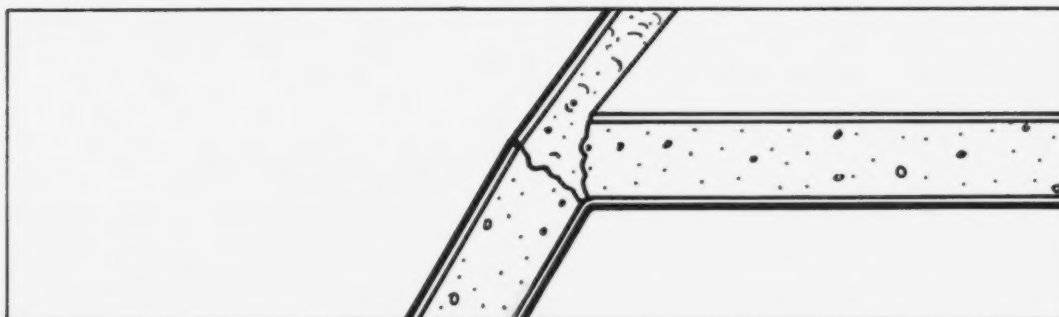
2. Measure accurately and mark or chalk your cut lines.



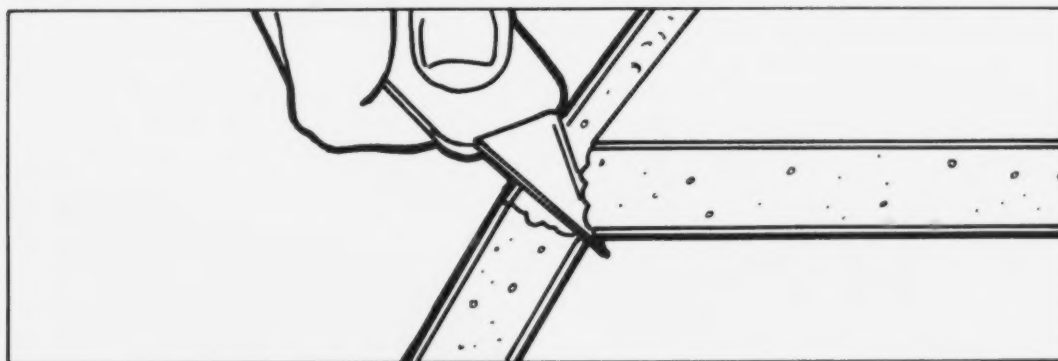
3. Follow the straight edge with your utility knife and score the sheetrock. Be sure to cleanly cut through one layer of paper and into the core.



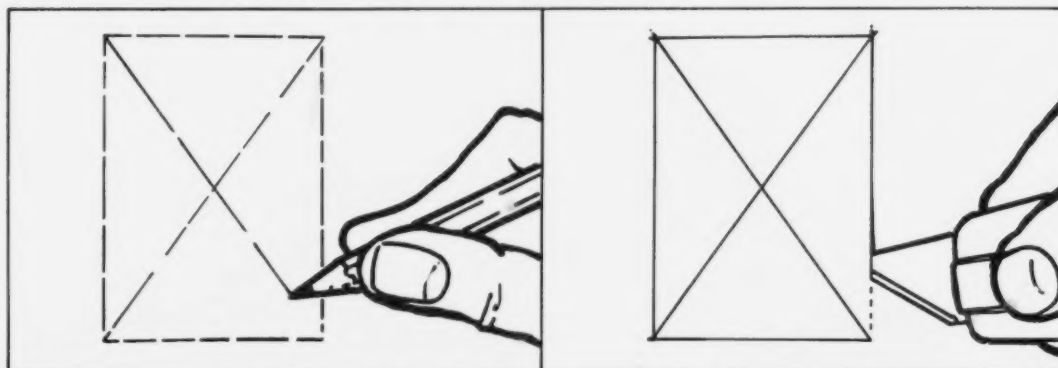
4. Once scored, bend the sheetrock back, snapping the gypsum.



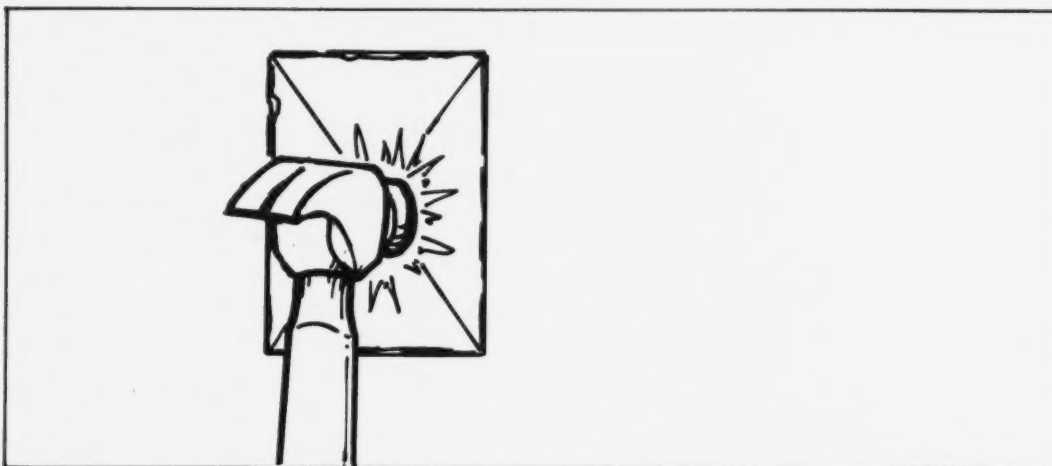
5. Then cut the back paper free. If the edges need to be smooth they can be trimmed with the utility knife or sanded.



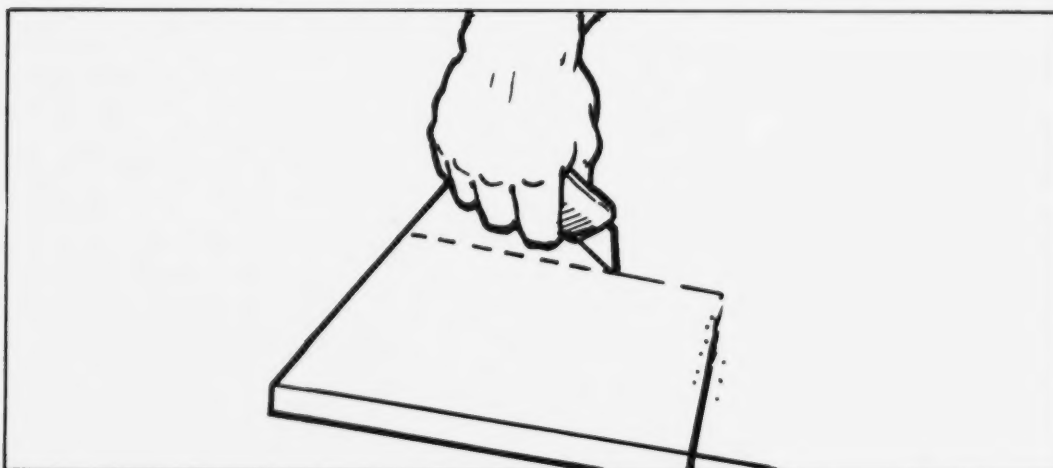
6. For electrical boxes, draw the box on the sheetrock with a pencil and then draw diagonal lines from corner to corner.



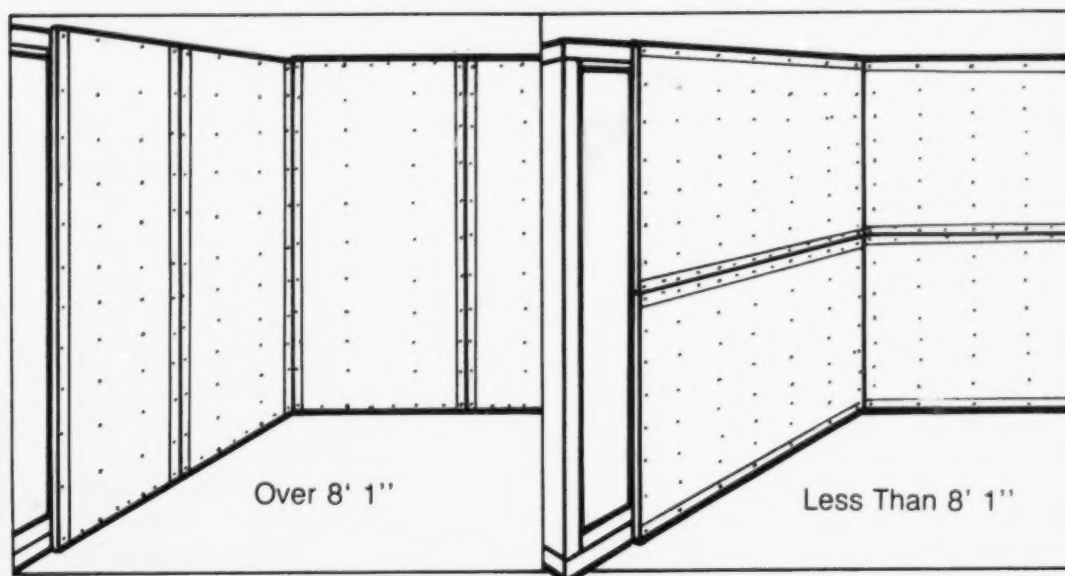
7. Now score all the lines including the X with a utility knife. Be sure to meet in the corners exactly.
8. Next hit the center of the X with a hammer and then trim the hole clean.



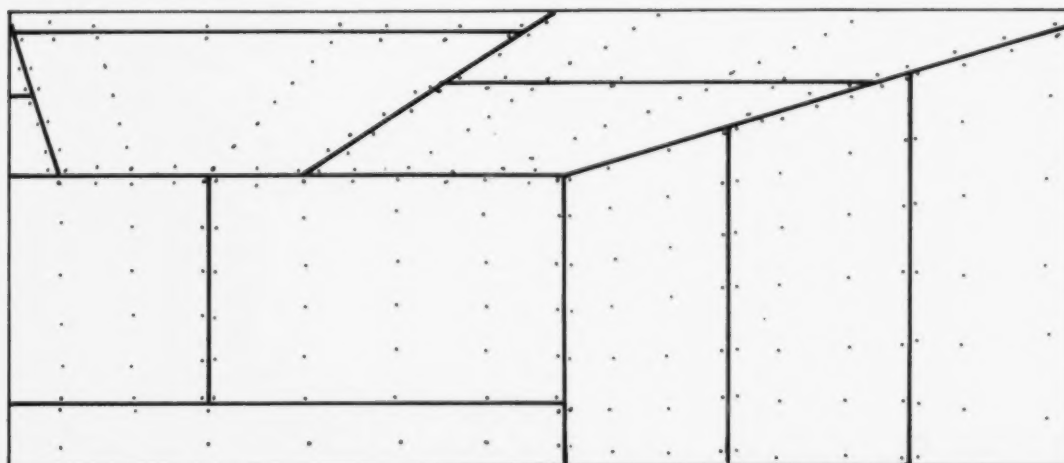
9. On a corner cut, use the sheetrock saw to cut the shortest cut, then score the other line and snap and trim in the usual way.



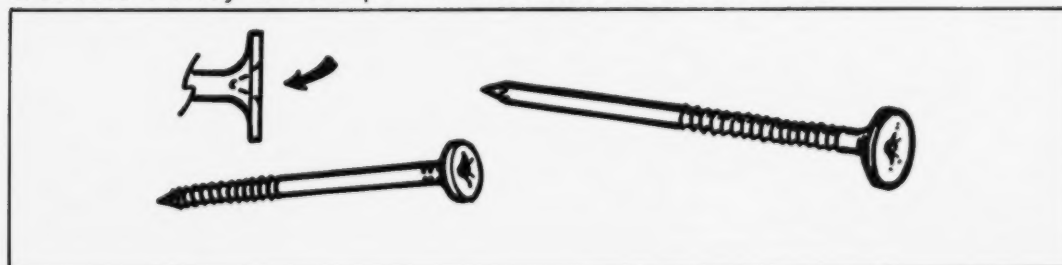
10. After the ceiling is cut and hung, the walls are next. On walls 8'1" or more in height the rock is hung vertically. On walls less than 8'1" in height the rock is hung horizontally.



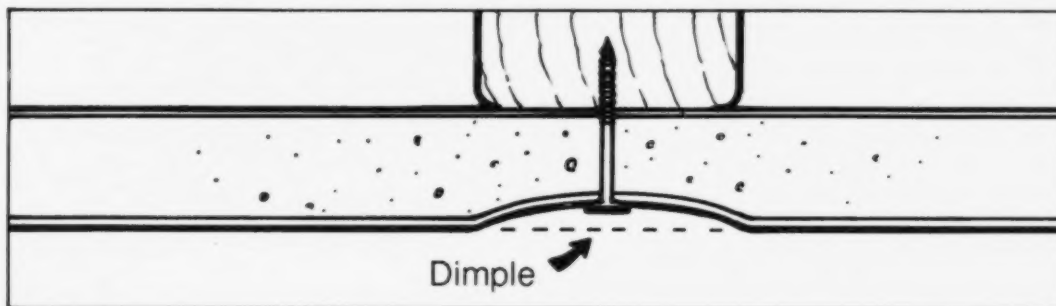
Be sure to start at the ceiling and work to the floor. Be careful to stagger any joints.



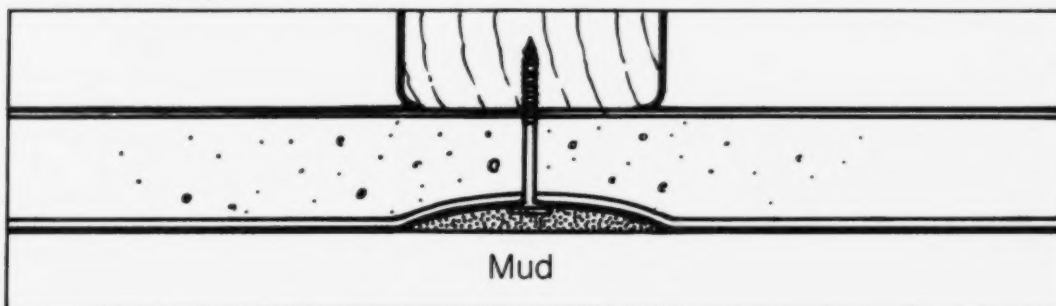
11. Sheetrock is either nailed, screwed or glued. Sheetrock nails have ring shanks and a shallow cupped head 1/4" to 5/16" in diameter. They should penetrate the stud at least 3/4".



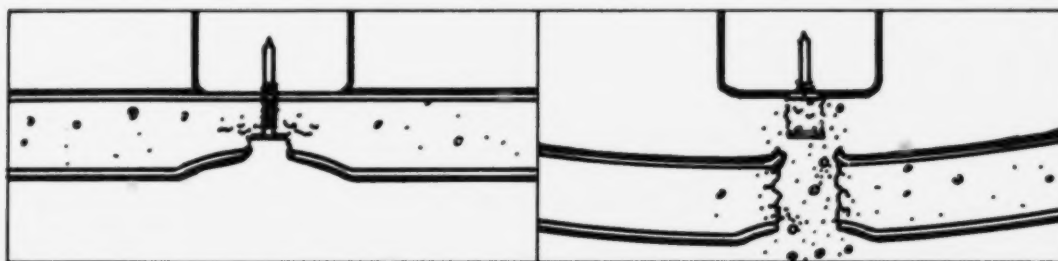
12. These nails should be driven with a crowned head hammer that will form a dimple (dent) in the sheetrock without tearing the paper. This dimple will allow the mud man to cover the nails with mud flush to the main wall surface with mud.



13. Drive the nail snug to the surface, then give it one extra blow to cause the dimple. Be careful not to break through the surface of the cover paper.

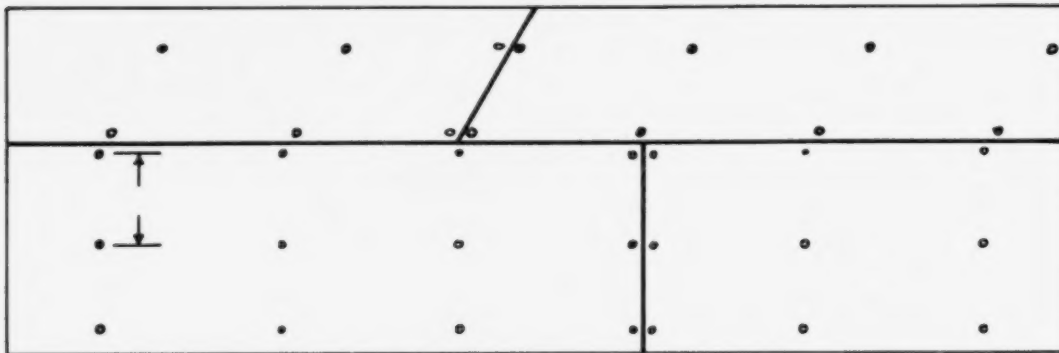


14. If the nail head breaks through the paper, the nail's holding power is lost and the head can pull completely through the sheetrock.

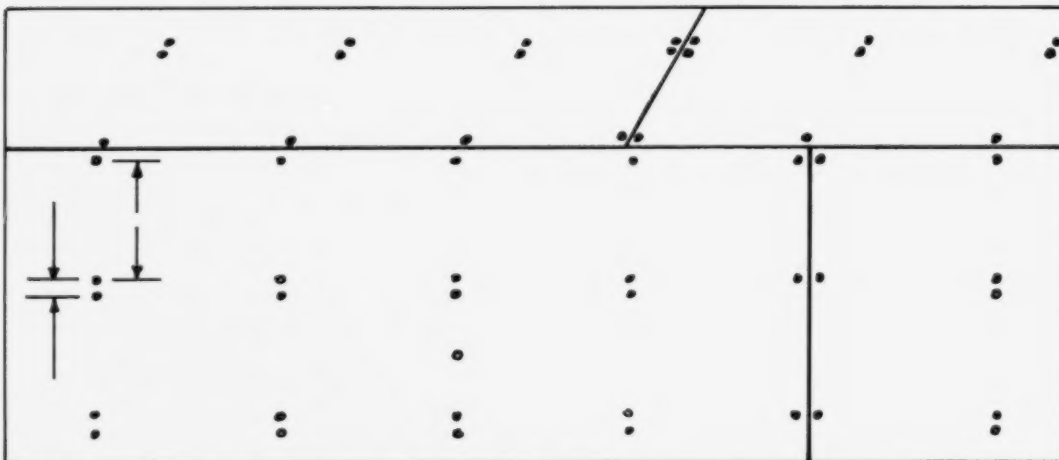


15. Once the sheetrock is tacked in place, chalk your nail lines down the joist or stud centers. Then nail from the center of the sheet outward.

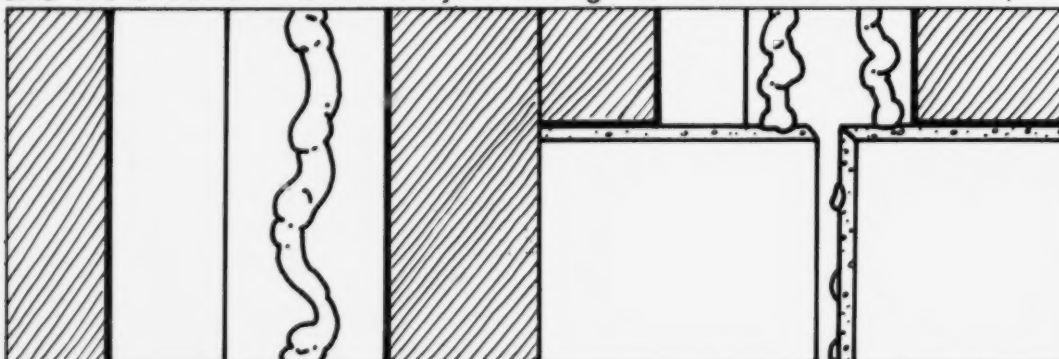
16. Sheetrock is nailed in different ways depending on the nail pattern or position of the sheetrock.
The single nail method spaces the nails a maximum of 7" apart (on center of stud) for ceilings and 8" apart (on center) for walls.



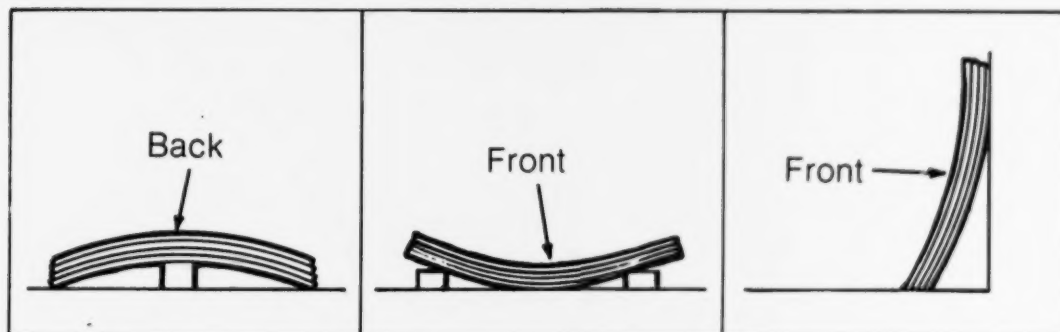
17. In the double nailing method the first set of nails are spaced 12" apart (on center) with the second set 2" to 2-1/2" from the first set.



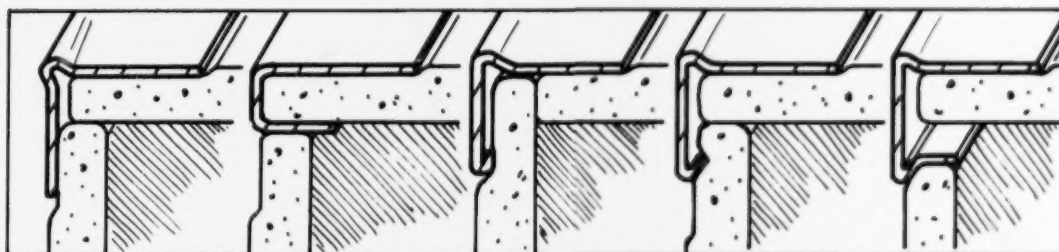
18. Screws are spaced 12" apart (on center) on ceilings and 16" apart (on center) on walls unless the studs are on 24" centers. In that case both ceilings and wall screws are 12" apart (on center).
19. When using adhesives, a 1/4 inch bead is run on each stud or joist and the sheetrock is tacked just enough to hold the sheetrock in place.



20. To ensure that the sheetrock is pressed tightly to the studs, the sheetrock is prebowed so that when it is nailed, it applies its own center pressure.



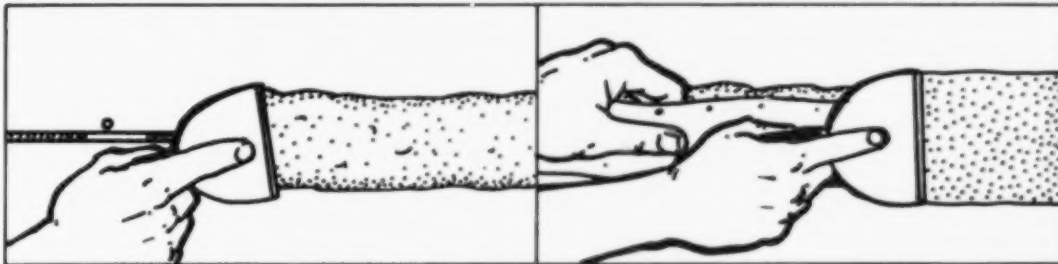
21. Sheetrock itself would make poor corners so there is a variety of metal hardware used with the mudding process to help form clean strong edges.



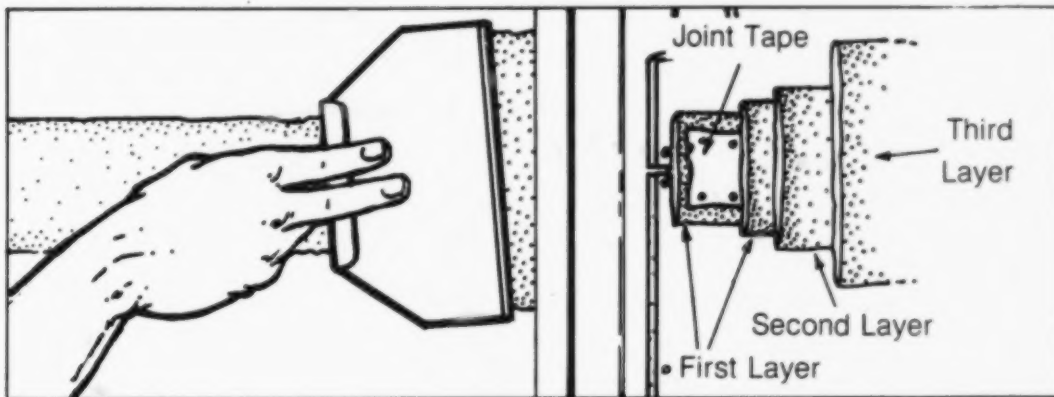
Building Trades - Carpentry
Installing Drywall

D. Applying Joint Tape and Compound

1. Gather necessary tools and materials.
2. All joints are mudded and taped using joint compound and joint tape. First a layer of joint compound is laid on to make a 'bed' for the joint tape.
3. Next the tape is applied with the joint knife, and a thin layer of mud is applied over the tape.



4. Once the mud is dry, a finish layer of mud is applied on top with a wide finish knife.



5. The joint is lightly sanded with a sanding stick, being careful not to fuzz the tape or cover paper.



CAUTION!

You should always protect eyes and lungs when sanding drywall.

6. Put away all supplies and equipment.
7. When hanging drywall, try to have as few joints as possible. Since sheetrock commonly comes in sheets 4' wide and 8', 10', 12', 14', or 16' long, you can often buy a sheet long enough to go across an entire wall.
If you must have joints, be sure to stagger them as much as possible.
Drywall is calculated in square feet. Be aware of what length of sheet you need when ordering your sheetrock.

Building Trades - Carpentry
Installing Drywall

E. Calculating Sheet Rock

Sheetrock is figured in square feet. The formulas are:

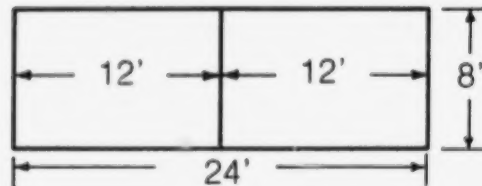
$$\text{Length} \times \text{Width} = \text{Area}$$

$$\frac{\text{Area to Be Covered}}{\text{Area of Sheet}} = \frac{\text{Number of}}{\text{Sheets Needed}}$$

Example:

A wall is 8' x 24'. How many sheets are needed?

1. Figure the area of the wall.
 $8' \times 24' = 192 \text{ square feet}$
2. Decide on the length of the sheetrock you will use. 8' would fit with no waste but would have a lot of joints. 10' will have waste. 12' will have no waste and few joints, so let us use 12'.

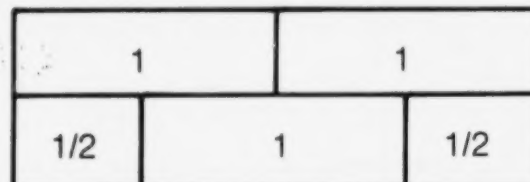


3. Calculate the square feet in one 4' x 12' piece of sheetrock.
 $4' \times 12' = 48 \text{ square feet}$



NOTE:

When hanging drywall cut one sheet in half so that the joints are staggered.



4. Divide the square feet of one sheet into the total square feet of the wall to tell you how many sheets you need.

$$192 \div 48 = 4 \text{ sheets}$$

So you need four 4' x 12' sheets of drywall for this wall.

Skill Sheet 1
Installing Drywall

Directions: Solve the problems here by using what you have learned in this unit.

1. A ceiling is 16' x 32'. How many 4' x 8' pieces of sheetrock are needed to cover it?
2. A room is 16' x 32' and 8' tall. How many 4' x 8' sheets are needed to do the whole room? (4 walls and the ceiling)
3. A room is 12' x 24' and 8' tall. How many sheets are needed for the walls and what would be the best size?

Building Trades - Carpentry
Installing Drywall

Unit Review

Directions: Match the following terms with their correct definitions by writing the correct letters in the blanks.

- | | |
|-----------------------------------|---|
| ___ 1. Mudding | A. Places where pieces of sheetrock meet |
| ___ 2. Regular gypsum board | B. Supports the ceiling sheetrock while it is being applied |
| ___ 3. Water resistant drywall | C. Applying a mixture of plaster compound and water to cover joints and nails |
| ___ 4. Type X (Fire Code) drywall | D. Generally used on walls and ceilings |
| ___ 5. Sheetrock | E. Another name for drywall |
| ___ 6. Deadman | F. Sheetrock used in kitchens and bathrooms |
| ___ 7. Joints | G. Fire resistant sheetrock |

Directions: Circle the letter of the best answer.

8. Which is not another name for drywall?
- | | |
|-----------------|-----------------|
| a. Sheetrock | c. Plasterboard |
| b. Gypsum board | d. Wallboard |
| e. Chipboard | |
9. What usually happens when a nail breaks through the paper on the sheetrock?
- | |
|--|
| a. The nail is crooked. |
| b. The head can pull completely through the sheet. |
| c. The board will move. |
10. How many layers of joint compound are usually applied?
- | | |
|------|------|
| a. 2 | c. 4 |
| b. 3 | d. 5 |

Directions: Calculate the answers to the following problems. Show your work and circle your answers.

11. How many 4'x12' sheets of sheetrock are needed to cover a ceiling that is 12' x 24'?

12. A room is 10 feet long, 16 feet wide, and 8 feet high. How many sheets are needed for the room (all for walls and the ceiling)? What would be the best size for the sheets?

Building Trades - Carpentry
Installing Drywall

Performance Checklist

Student _____ has successfully performed the following steps of procedure.

Cutting and Hanging Sheetrock	Yes	No	Comments
1. Gathered all necessary materials and equipment			
2. Measured and chalked the lines to be cut			
3. Scored the sheetrock			
4. Bent the sheetrock to break the gypsum			
5. Cut paper and sanded or trimmed the edges			
6. Marked and cut out electrical boxes or openings			
7. Made corner cuts			
8. Started at ceiling and worked toward the floor			
9. Tacked sheetrock into place, making a slight dimple in the surface			
10. Nailed, screwed, or glued sheetrock to studs			
Applying Joint Tape and Compound	Yes	No	Comments
1. Applied layer of joint compound			
2. Applied tape with joint compound and immediately covered it with a thin layer of joint compound			
3. Applied finish layer of compound			
4. Sanded joint lightly			

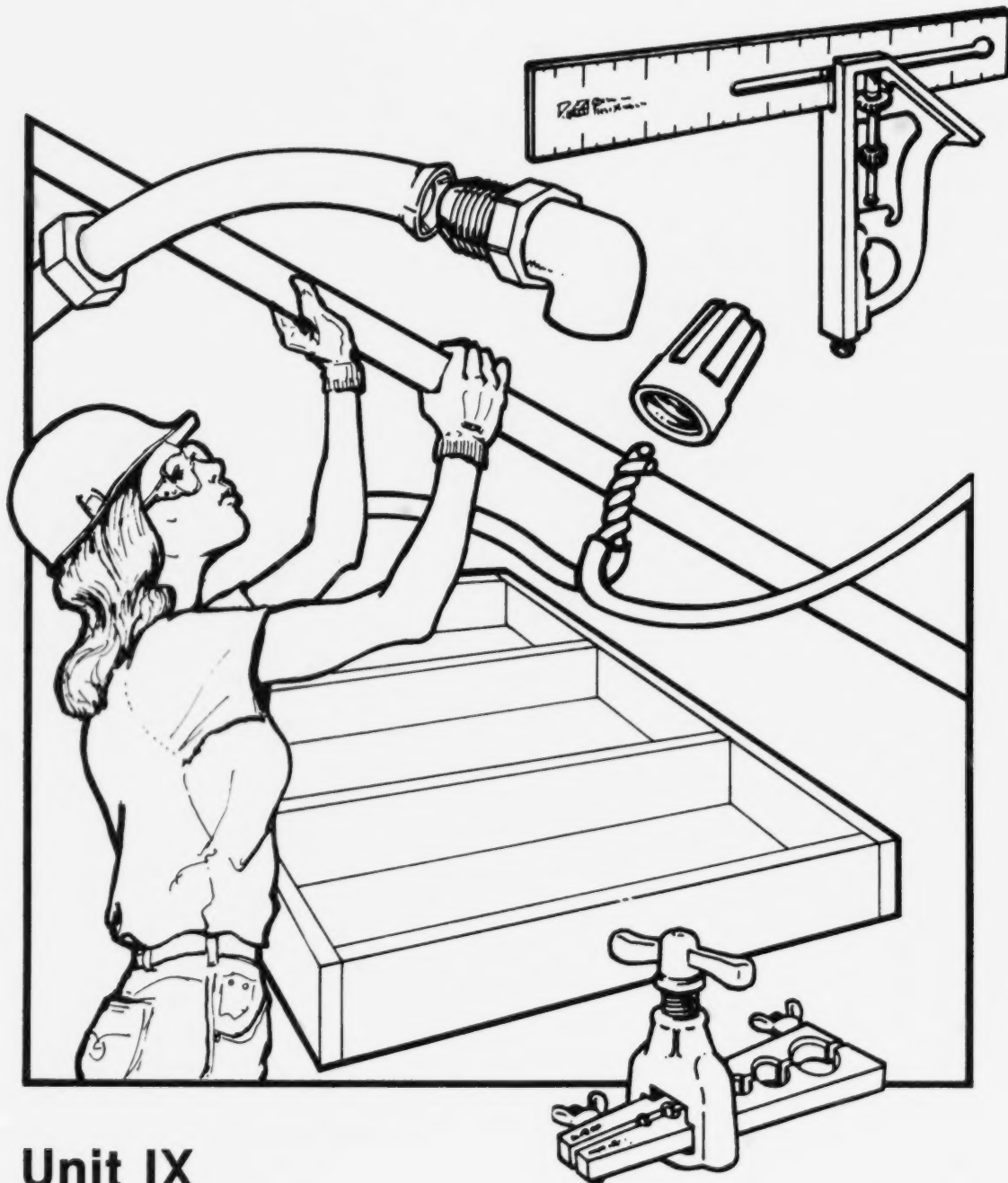
Calculating Drywall	Yes	No	Comments
1. Figured area to be covered			
2. Figured area of sheet			
3. Calculated number of sheets needed			

Should Move On ☐

Repeat This Unit ☐

Student's Signature/Date

Instructor's Signature/Date



Unit IX

Painting

Painting

Painting

After studying this unit, you will be able to:

1. Identify types of paint and painting equipment.
2. Paint an interior wall with brush, roller, and water-base paint.
3. Calculate amount of paint needed to cover a given area.

Check the Statement that Fits You Best

☐

I can do these tasks and want to go through the Performance Checklist.



SEE YOUR INSTRUCTOR

☐

I want to study the information in this unit before I do the Performance Checklist.



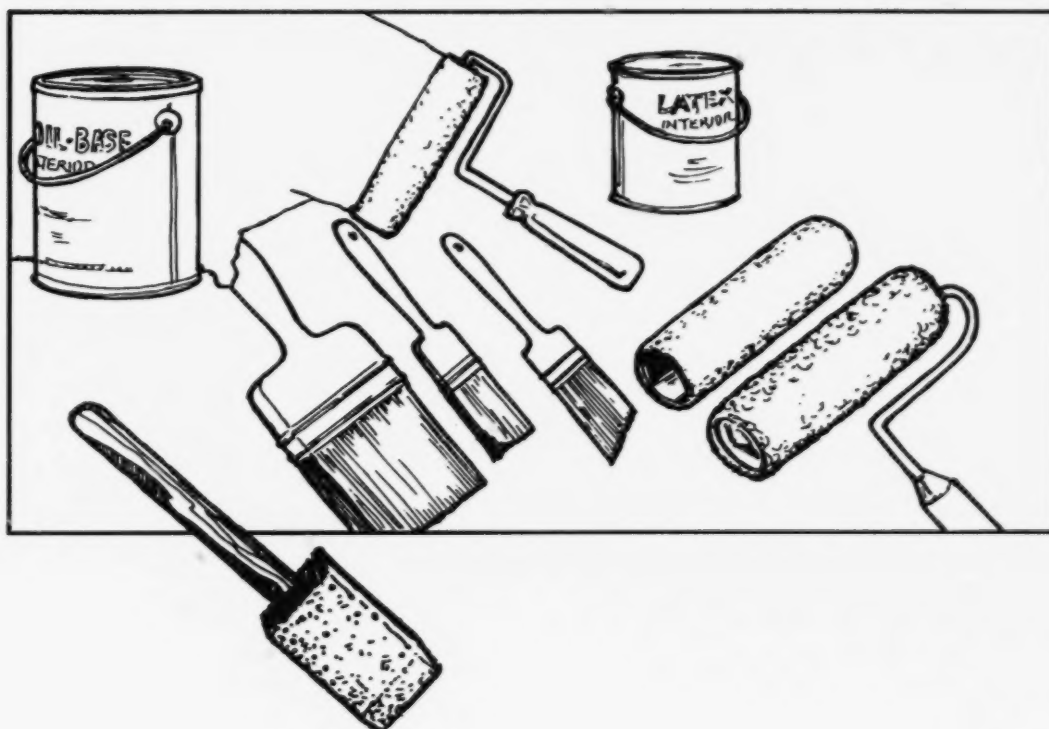
TURN PAGE AND BEGIN

Painting

Introduction

Paint can make a building or wall look new, clean, and fresh. Paint protects building surfaces from damage by weather and moisture or dirt and grease.

A painter will need to know about paints and how to properly apply them. In this unit, you will learn about paint and painting equipment, how to paint a wall, and how to calculate the amount of paint you will need.

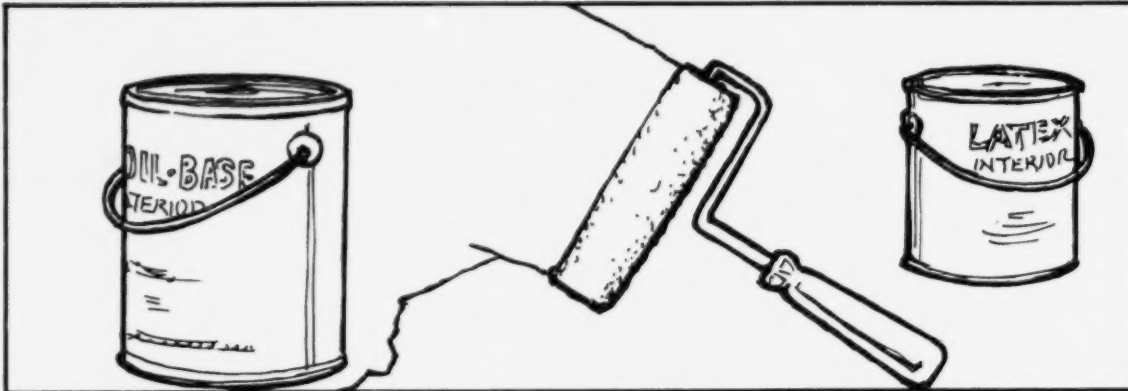


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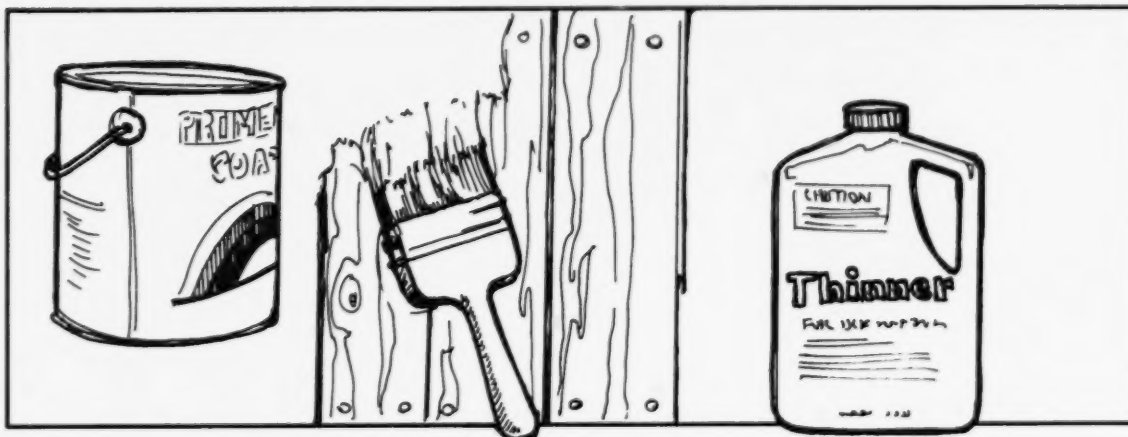
Painting

A. Types of Paint and Painting Equipment

1. Paint - liquid that is brushed, rolled, or sprayed on surfaces to protect it from weather, moisture, wear, and dirt. The two most common types of paint are water-base and oil-base paints.



2. Latex Paint - a water-base paint. It may be labeled "vinyl" or "acrylic" paint. It is used for either interior (inside) or exterior (outside) use. It can be cleaned up with water when still wet.
3. Oil-Base Paint - slow drying paint that contains oil. It too is used for exterior and interior surfaces. It needs a "paint-thinner" or alcohol for cleanup.
4. Primer - a base-coat of paint for unpainted surfaces.



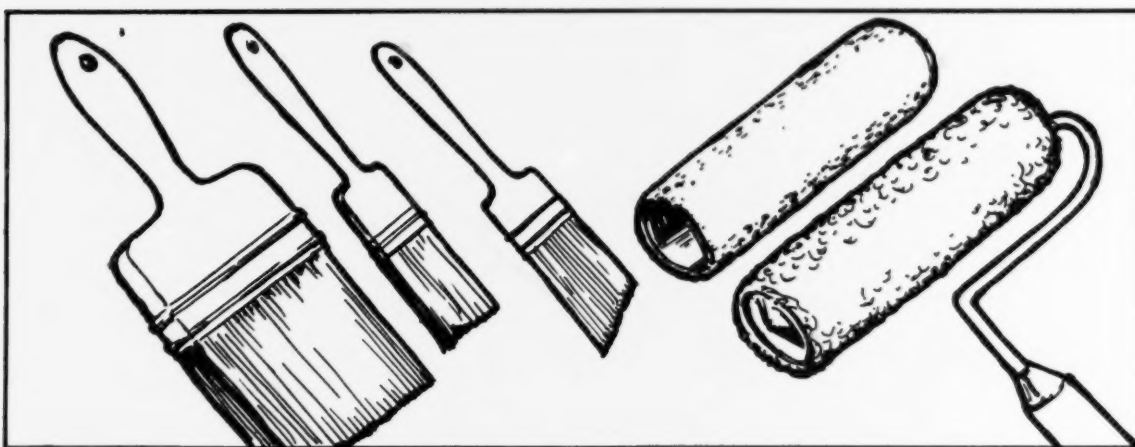
5. Paint Thinner - liquid used to "thin" oil-base paint and to clean equipment, brushes, and drips.

6. Paint Brushes - come in different sizes and shapes. The brush part itself is also made from different materials for use with different paints.
7. Rollers - are used to apply paint to a large area. They vary in size and roller thicknesses to cover different types of surfaces.

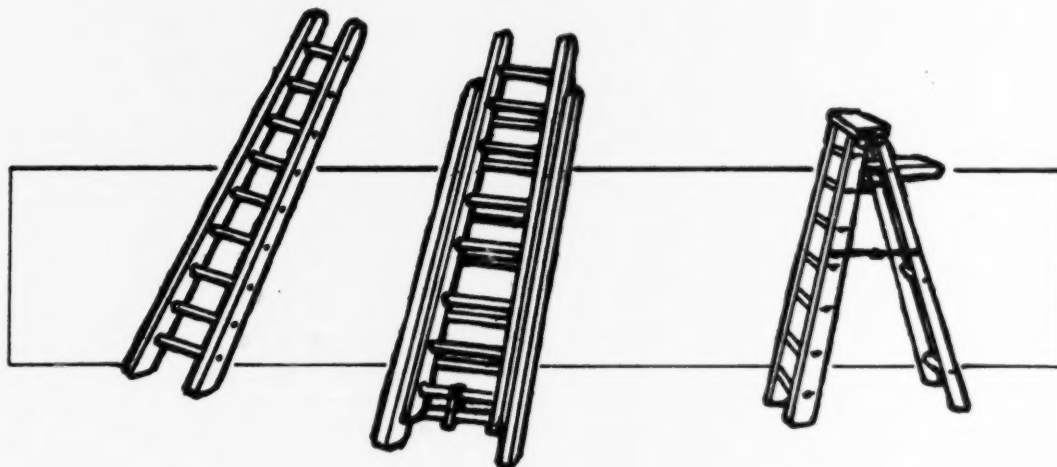
NOTE:

Extension handles are available for rollers to allow the painter a greater reach.

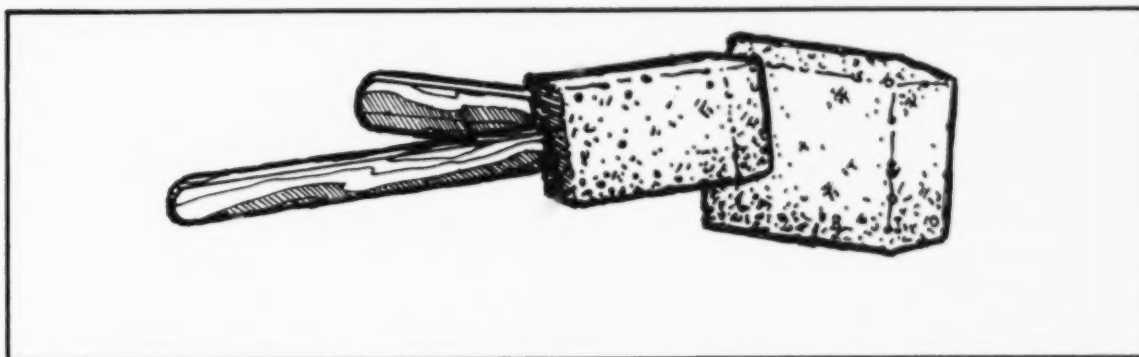
8. Roller Tray - container to hold paint when using the roller.



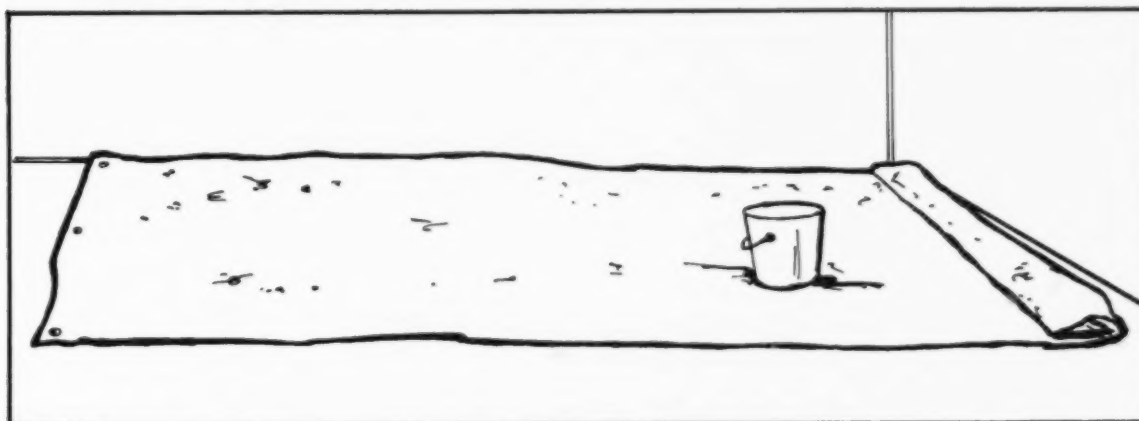
9. Ladder - used for access to high and hard-to-reach places from the floor.



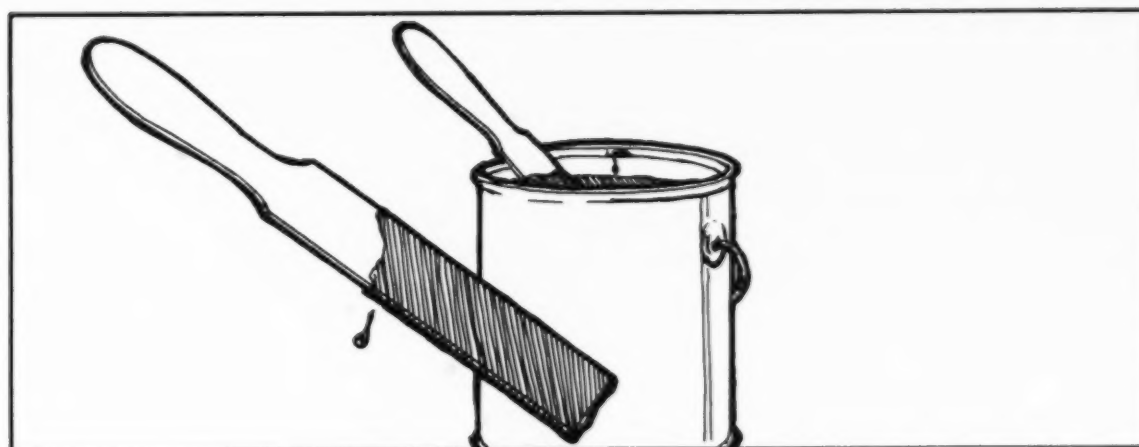
10. Pads - disposable foam pads used for paint applicators.



11. Drop Cloth - cloth or plastic sheets used to cover and protect floors and furniture when painting.



12. Mixing Paddle - used to stir paint after it has been sitting. Paint must be stirred to maintain its consistency.



Building Trades - Carpentry
Painting

B. Painting an Interior Wall

1. Find and check off the following equipment.

☐ WATER-BASE PAINT

☐ PAINT PAIL

☐ ROLLER TRAY



☐ MIXING PADDLE

☐ DAMP CLOTH

☐ STEPLADDER



☐ DROP CLOTH

☐ SMALL BRUSH



☐ LARGE ROLLER W/COVER



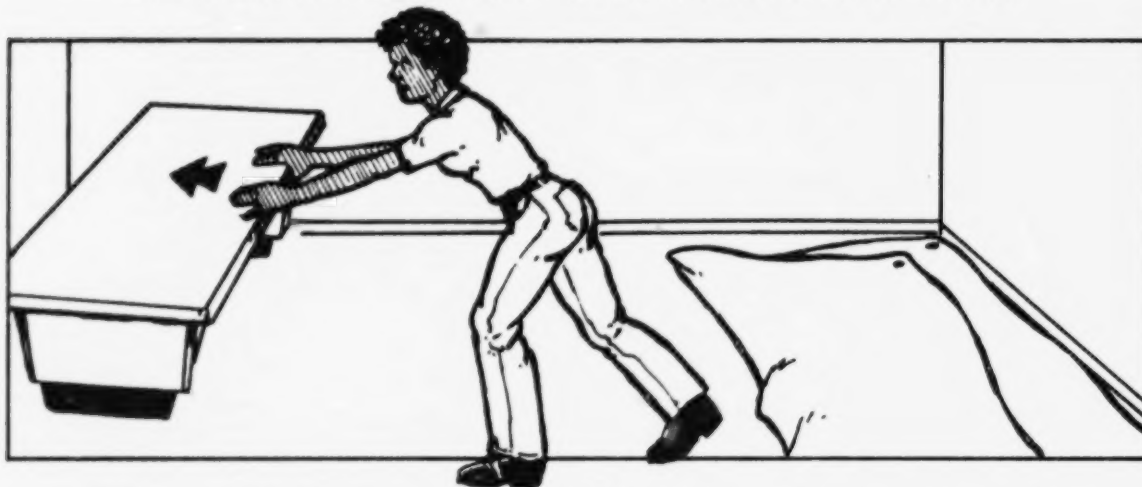
2. Locate wall or part of wall you will paint. Be sure wall has been properly prepared for painting.

NOTE:

A properly prepared wall will be clean, dry, and have the rough spots sanded and primed.



3. Move any furniture that is against the wall. Spread drop cloth on floor under the wall or over furniture that can't be moved.



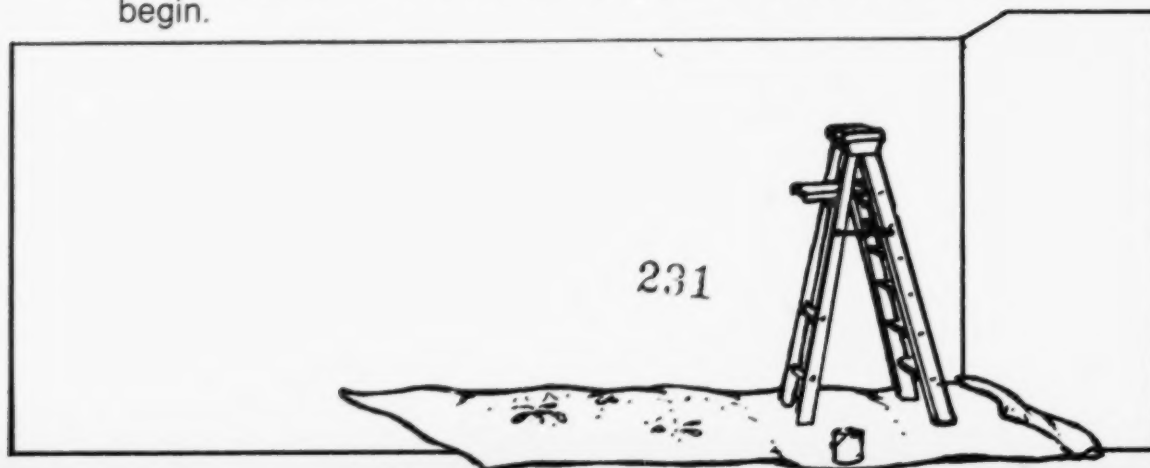
4. Open can of water-base paint. Stir paint until it is smooth. Pour some into the paint pail.

NOTE:

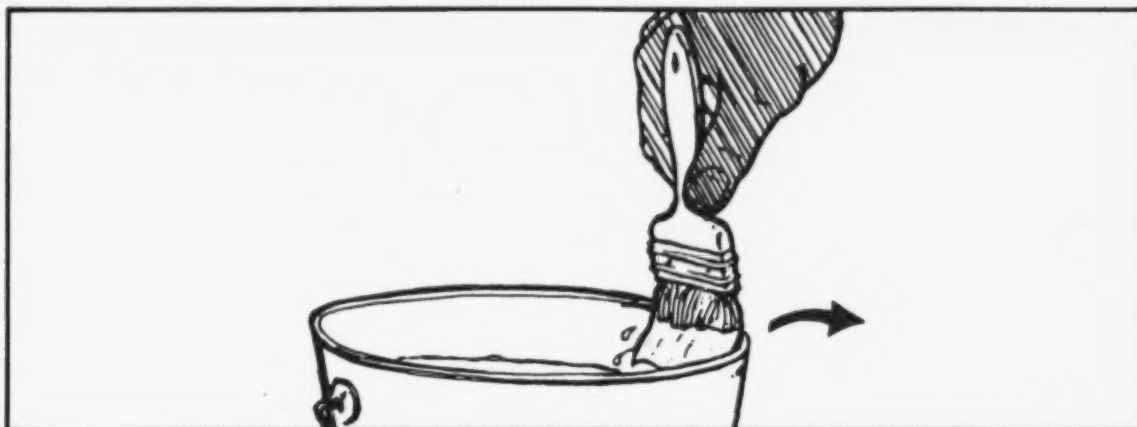
When painting, protect your clothing with coveralls or an apron; or wear clothing that you can get paint on.



5. Move stepladder to a corner of the wall where you intend to begin.



6. Dip paint brush about half-way into paint several times. Gently tap both sides of brush against the inside of the paint pail.



7. Beginning at the upper corner, start painting a narrow strip around edges of the wall.

CAUTION!

Remember to observe ladder safety rules.



8. Paint a strip completely around the wall section.

NOTE:

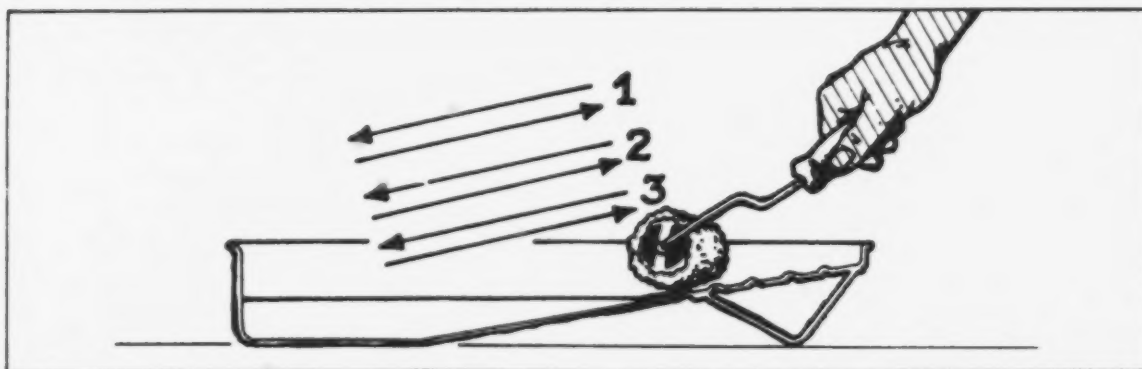
When finished with the brush, clean it with warm water or place it in a damp cloth for cleaning later.



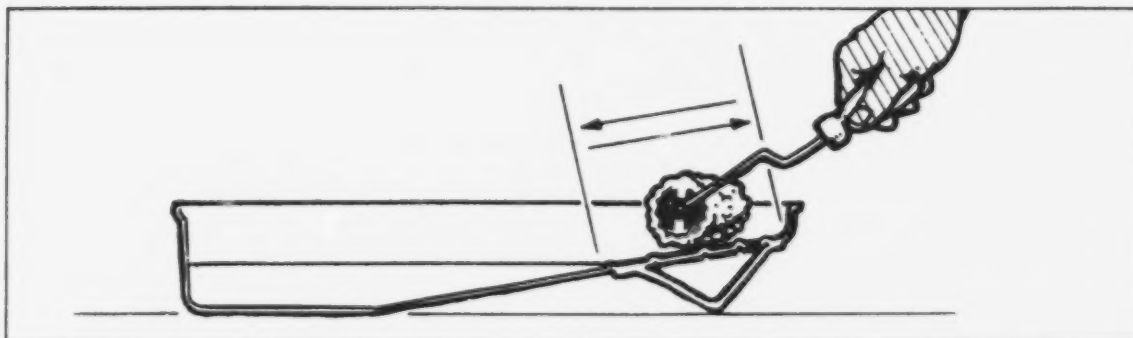
9. Stir paint again and pour some into the roller tray. Pour paint about half-way up sloping bottom of the tray.



10. Place tray on stepladder shelf.
11. Roll paint roller into and out of paint two or three times until an even covering of paint is on it.



12. To avoid dripping paint, lightly roll the roller back and forth on ridged part of tray to remove excess paint.

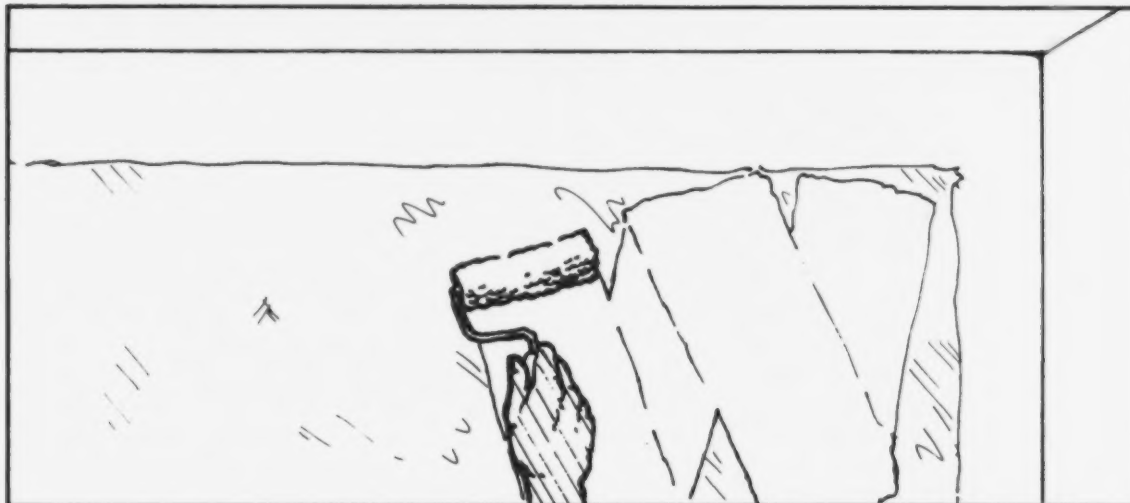


13. Begin roller painting across the top of the wall.

14. Roll the wall in different directions, keeping the roller in contact with the wall.

NOTE:

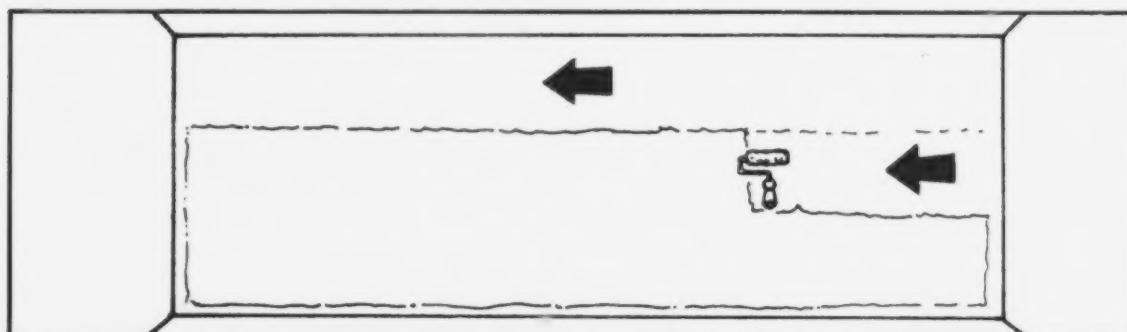
Dip paint roller in roller tray as often as needed to apply a consistent amount of paint to the wall.



15. Smooth and blend paint with horizontal strokes.



16. Paint in strips across the wall. Work your way down the wall until it is completely covered.

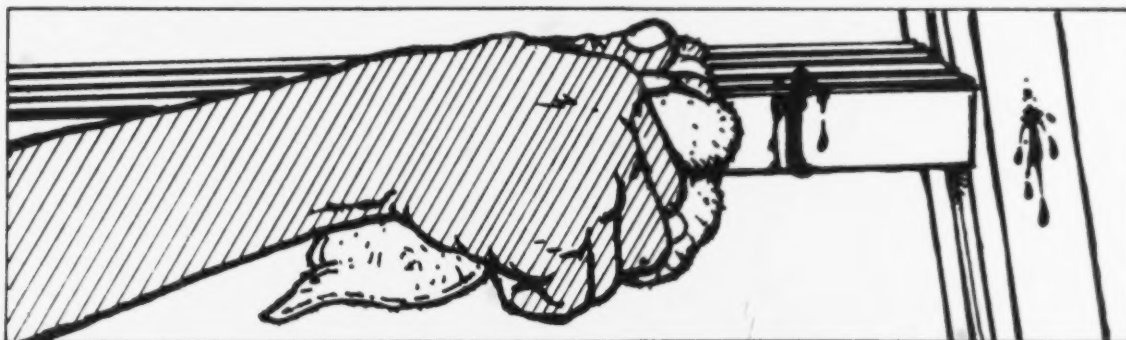


17. Look for signs of the previous paint or primer coat of paint showing through to decide if a second coat is needed.

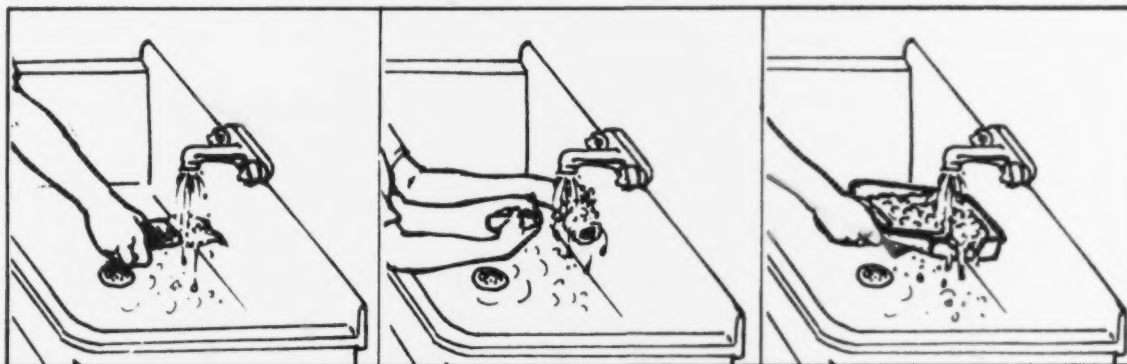
NOTE:

Be sure paint is dry before applying second coat.

18. Look for drips and spills on woodwork, floor, and equipment. Wipe up spills with a damp cloth.

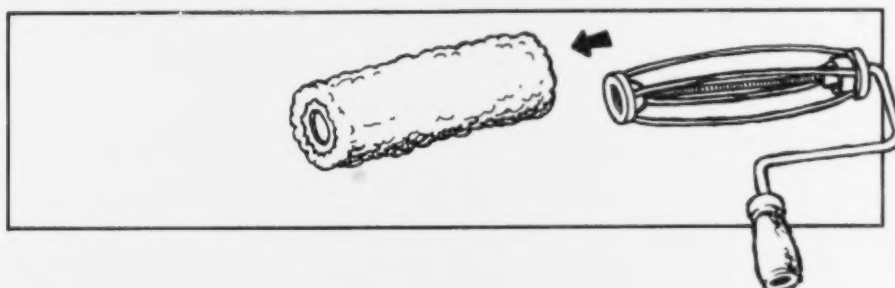


19. Pour remaining paint back into paint can and tightly close the lid. Clean brushes, rollers, pails, and trays in warm soapy water. Rinse thoroughly and hang up to dry.

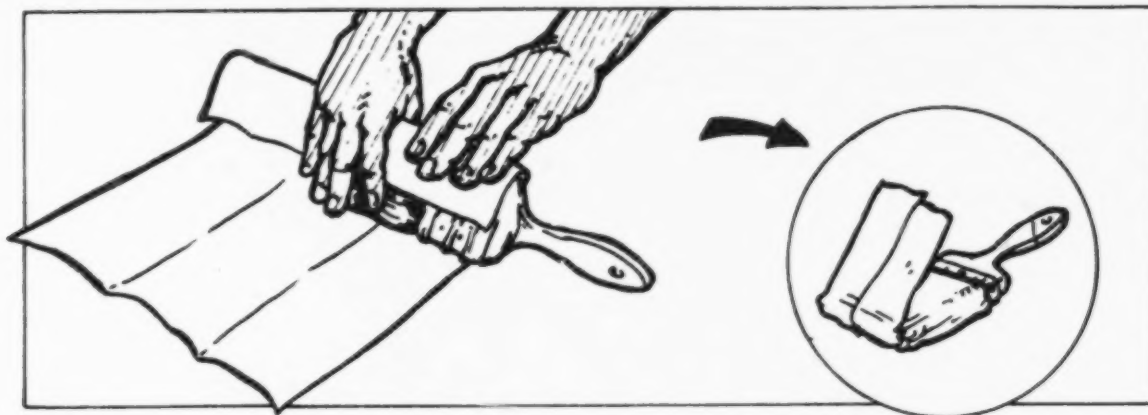


NOTE:

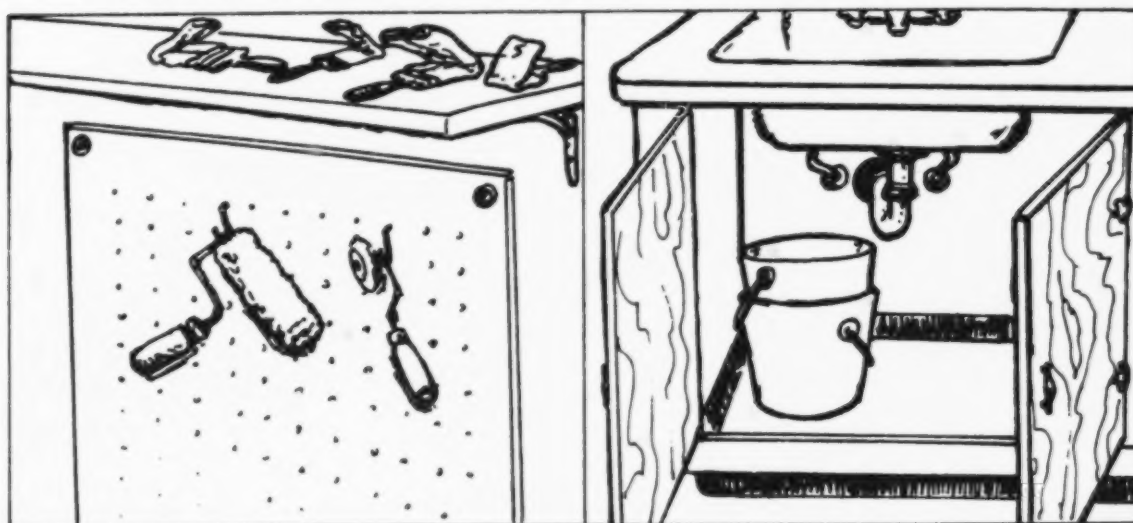
Remove the roller cover from the handle and wash these parts separately.



20. After brushes and rollers have dried, place them in their original wrapper or wrap them in heavy paper or plastic for protection. Hang brushes by their handles or lay them flat for storage.



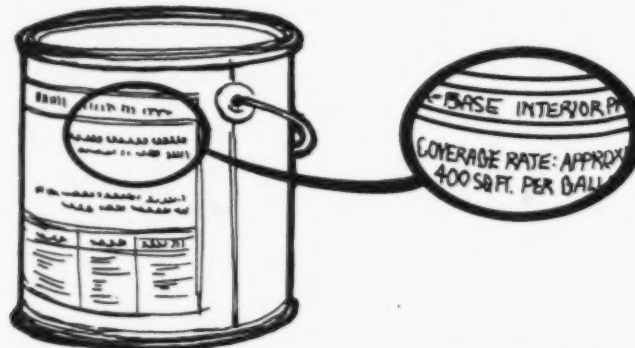
21. Remove drop cloth and stepladder, and return all equipment to its proper place.



22. Report to your supervisor or instructor.

C. Calculating Amount of Paint Needed for a Given Area

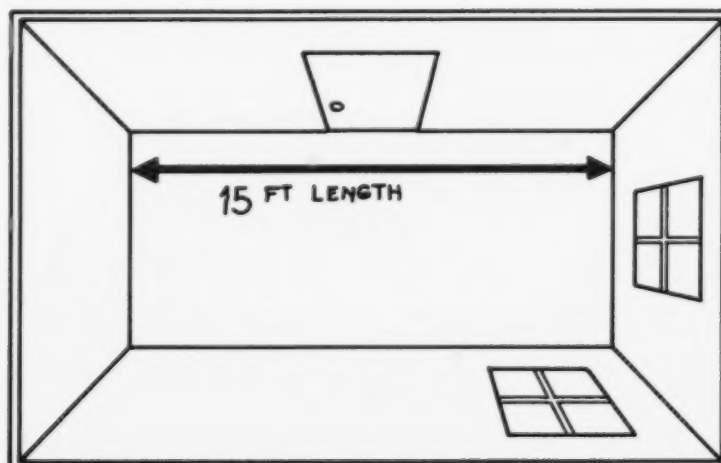
To figure how much paint is needed to cover a certain area, you must know some basic math skills and have some information about the paint you are using and the area you are painting.



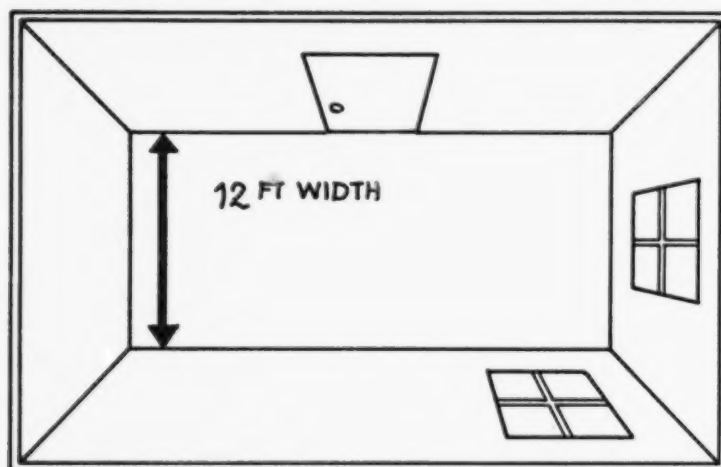
How much area a gallon of paint will cover is called its spreading or cover rate. This rate is for ideal situations such as smooth, already primed surfaces. A gallon of paint under these conditions usually covers about 400 square feet of surface. If the surface is not primed or has a rough textured finish, the spreading or cover rate will not be as high (the paint will not cover as much area).

In addition to knowing paint spreading or cover rate, a painter needs to also know how large the area to be painted is.

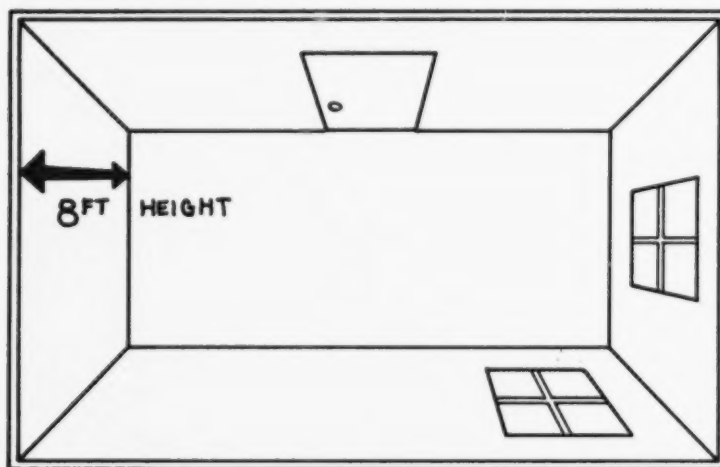
1. To determine how large the area to be painted is, you must first measure the length of the room.



2. Next, you need to measure the width of the room...



3. And you need to measure the height of the room.



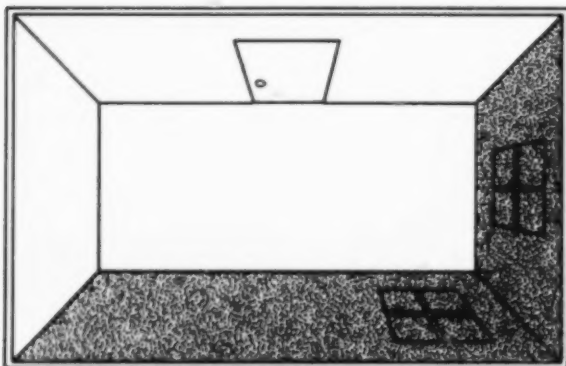
4. Using these figures, add the length of the room to the width of the room.

$$15^{\text{FT}} \text{ LENGTH} + 12^{\text{FT}} \text{ WIDTH} = 27^{\text{FT}}$$

5. Multiply that number by the height of the room...

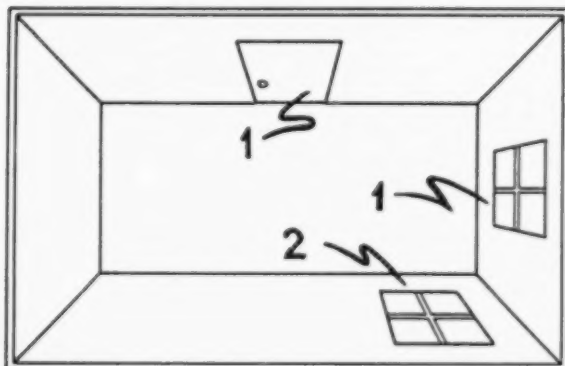
$$27^{\text{FT}} \times 8^{\text{FT HEIGHT}} = 216^{\text{SQ FT}}$$

6. This gives you the square feet or area for half of the room (one length wall and one width wall). Multiply this number by 2 to get the square feet of the whole room.



$$\begin{array}{r} 216^{\text{SQ FT}} \\ \times 2 \\ \hline 432^{\text{SQ FT}} \end{array}$$

7. You won't want to paint the windows and doors with the same paint so you need to subtract the space (area) that they occupy. To figure how much area to subtract, start by counting windows and doors in the room.



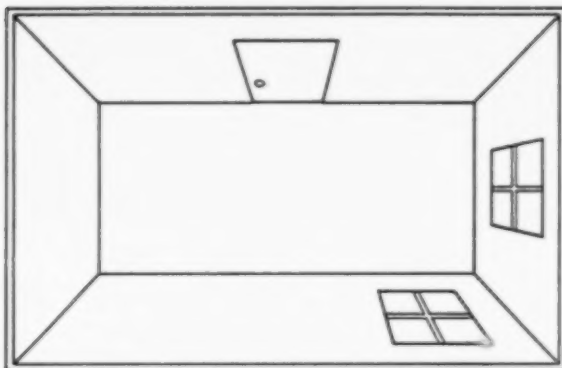
1 DOOR
2 WINDOWS

8. Subtract 15 square feet for each window and 21 square feet for each door.

$$1 \text{ DOOR} \times 21^{\text{SQ FT}} \quad \text{OR} \quad 21^{\text{SQ FT}}$$

$$2 \text{ WINDOWS} \times 15^{\text{SQ FT}} \quad \text{OR} \quad 30^{\text{SQ FT}}$$

9. The total square feet of the area, minus the doors and windows is the area you need paint to cover.



$$\begin{array}{r} 432 \text{ SQ FT} \\ 51 \text{ SQ FT} \\ \hline 381 \text{ SQ FT} \end{array}$$

10. To determine how much paint it will take to cover this area, divide the area (total square feet) by the spreading or cover rate of the paint. This should be listed on the paint can.

COVER RATE

400 SQ FT / .95% OF ONE GALLON IS NEEDED

$$\begin{array}{r} 400 \text{ SQ FT} / 381 \text{ SQ FT} \\ \hline 360.00 \\ \hline 21.00 \\ 20.00 \end{array}$$

11. Remember, if you are painting an unprimed or rough textured surface, the paint will not cover as much area (usually about 50 square feet less).

NOTE:

A handy figure to remember when painting is that a gallon of paint will usually cover a room 15 feet long by 12 feet wide by 8 feet high.

SEE YOUR INSTRUCTOR

Painting

Unit Review

Directions: Match the correct name of the painting equipment with its picture by putting the correct letter in the blank space. Choose from these words:

- A. Roller
- B. Stepladder

- C. Brush
- D. Drop Cloth

- E. Paint Pail
- F. Paint Pads

1. _____



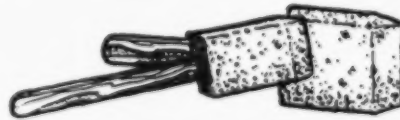
4. _____



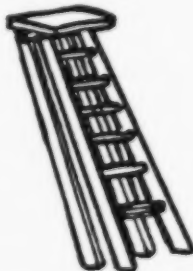
2. _____



5. _____



3. _____

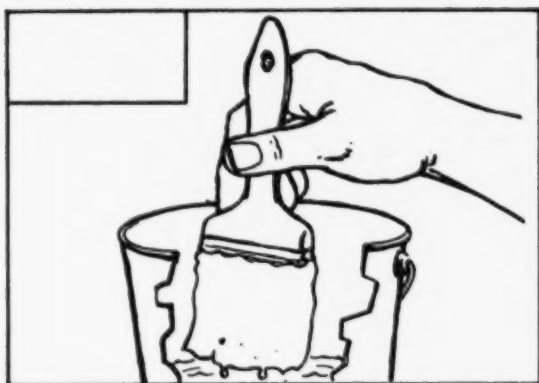


6. _____

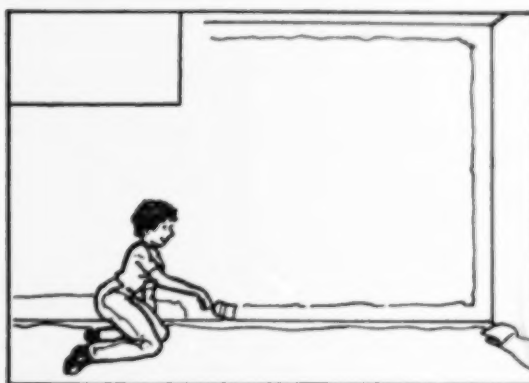


Directions: Write YES by the pictures that show the correct painting method. Write NO by those that do not.

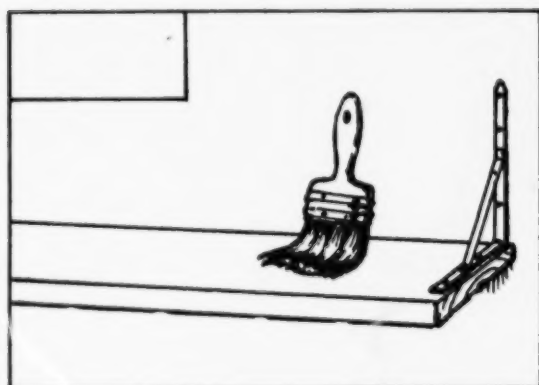
7.



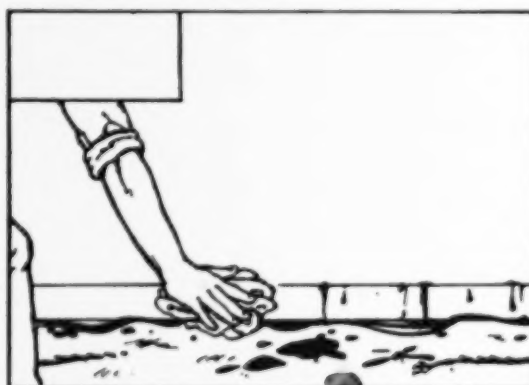
10.



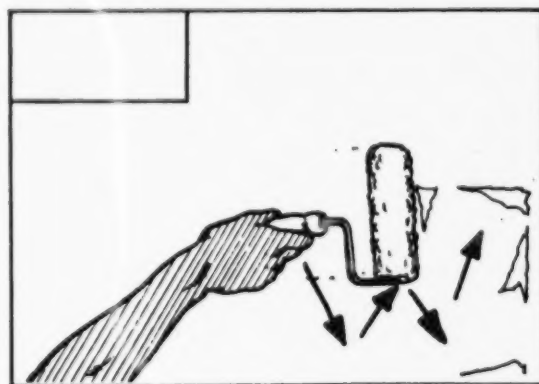
8.



11.



9.



12.



Directions: Match the type of paint with its correct definition by putting the correct letter in the blank space.

_____ 13. Latex Paint

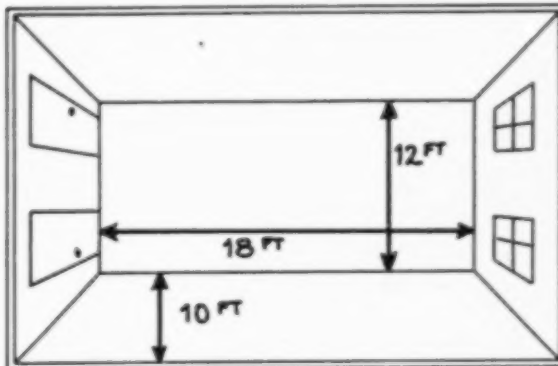
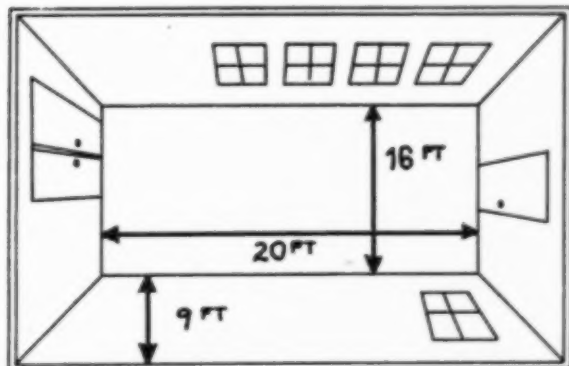
A. An oil-base paint

_____ 14. Oil Paint

B. A water-base paint

Directions: Calculate the area for each of the following rooms. Show your work.

If a gallon of paint covers approximately 400 square feet of area, how many gallons of paint will you need to buy to paint each room? Show how you figure this.



15. TOTAL SQUARE FEET
TO BE PAINTED: _____

16. PAINT NEEDED IN
GALLONS: _____

17. TOTAL SQUARE FEET TO
BE PAINTED: _____

18. PAINT NEEDED IN
GALLONS: _____

Building Trades - Carpentry
Painting

Performance Checklist

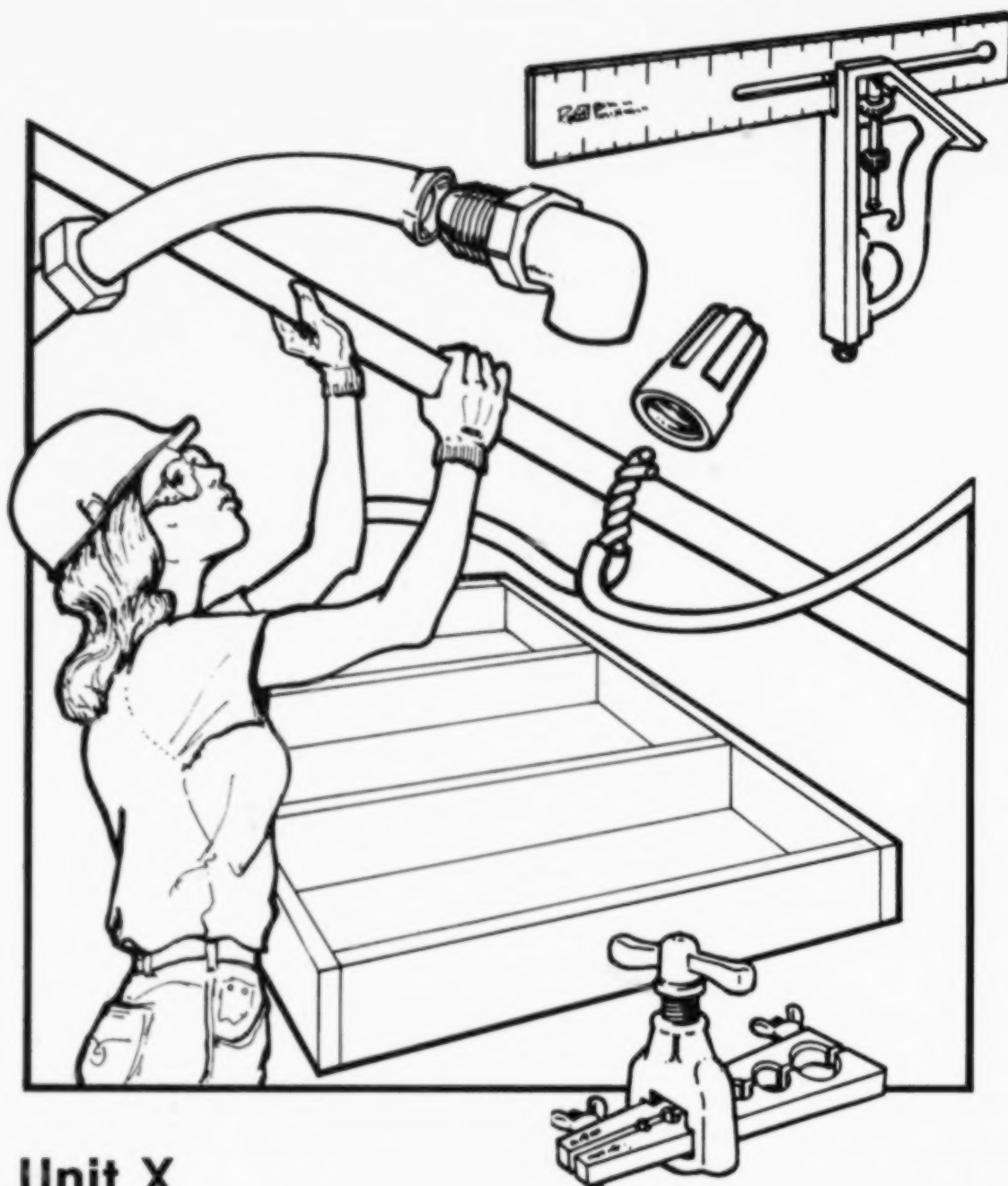
Student _____ has successfully performed the following steps of procedure.

Paint and Painting Equipment	Yes	No	Comments
1. Identified different types of paint			
2. Identified painting equipment			
Painting an Interior Wall			
1. Assembled equipment for painting			
2. Located area to be painted			
3. Moved furniture and spread drop cloth			
4. Opened, stirred, and poured paint into pail			
5. Moved stepladder to proper location			
6. Properly dipped paint brush			
7. Painted strip around wall			
8. Properly poured paint into roller tray			
9. Properly dipped roller			
10. Properly painted wall with roller			
11. Applied second coat if necessary			
12. Wiped up any drips and spills			
13. Cleaned brushes, rollers, pails, and trays			
14. Properly stored brushes, rollers, and equipment			
Calculating Amount of Paint Needed			
1. Measured length of room			
2. Measured width of room			
3. Measured height of room			
4. Added length to width			
5. Multiplied that number by height of room			
6. Multiplied number by 2 to get square feet			
7. Subtracted area of doors and windows to get area to be painted			
8. Divided this area by spread or cover rate of paint to determine gallons needed			

Should Move On ☐
Repeat This Unit ☐

Instructor Signature/Date

Student Signature/Date



Unit X

Wiring Tools and Their Uses

Building Trades - Electrical Construction
Wiring Tools and Their Uses

Wiring Tools and Their Uses

After studying this unit, you will be able to:

1. Identify tools used in electrical wiring.
2. Match an electrical tool with its most common use.

Check the Statement that Fits You Best

☐

I can do these tasks and want to go through the
Performance Checklist.



SEE YOUR INSTRUCTOR

☐

I want to study the information in this unit before I
do the Performance Checklist.



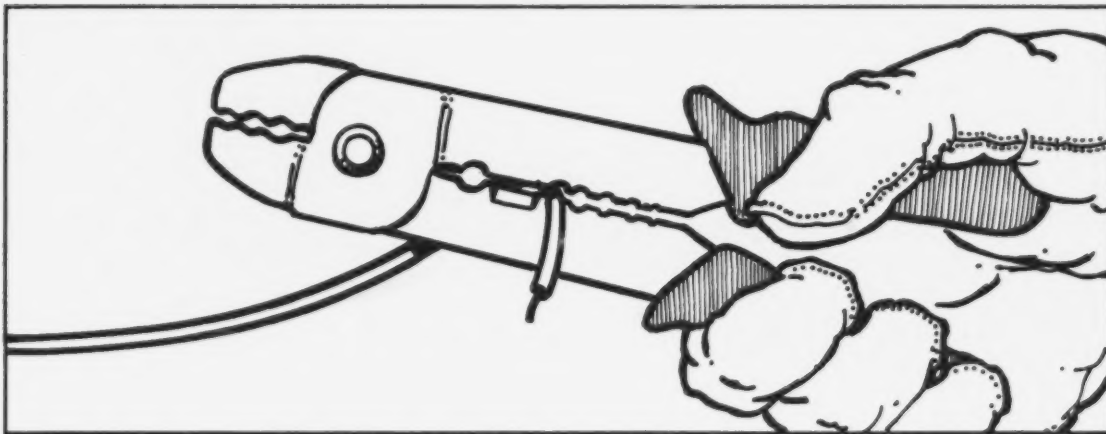
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Building Trades - Electrical Construction

Wiring Tools and Their Uses

Introduction

Certain tools are needed to do electrical wiring work correctly. Some of these tools, such as a measuring tape, are very common and can be used in many other jobs. Other tools, such as a wire stripper, are used only in electrical wiring. It is important to be able to recognize tools and their uses so that you can choose the correct tools to do an electrical job quickly and safely.



In this unit, you will learn about electrical wiring tools and their uses.

TURN TO NEXT PAGE

Building Trades - Electrical Construction

Wiring Tools and Their Uses

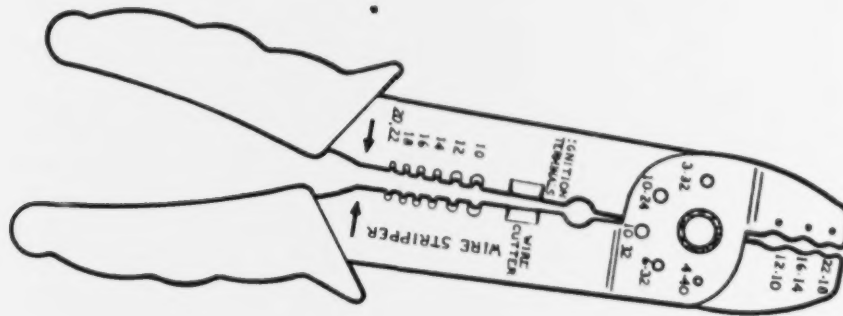
A. Terms and Equipment

1. Cable - an insulated conductor of electricity that has at least two wires
2. Conduit - a pipe for carrying wires
3. Insulation - material that does not carry current; used on the outside of wires
4. Junction Box - a box in which wires are joined together
5. Knockout - a die cut circle in outlet and switch boxes that may be removed to allow wiring to enter and exit from the boxes
6. Laying Out - making a pattern; marking places to drill, cut, and install
7. Non-Metallic - not made of metal
8. Rigid - does not bend
9. Splice - a connection made with two or more wires
10. Voltage - the amount of pressure that moves electricity through wires

Building Trades - Electrical Construction
Wiring Tools and Their Uses

B. Wiring Tools and Their Uses

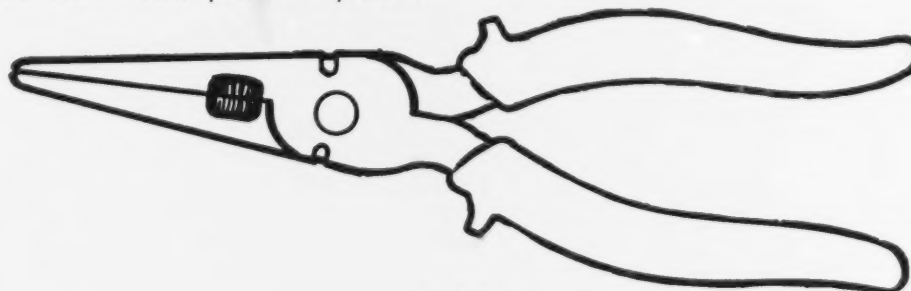
1. Wire Cutter/Stripper: The wire stripper/cutter is used to remove insulation from electrical wire and to cut the wire.



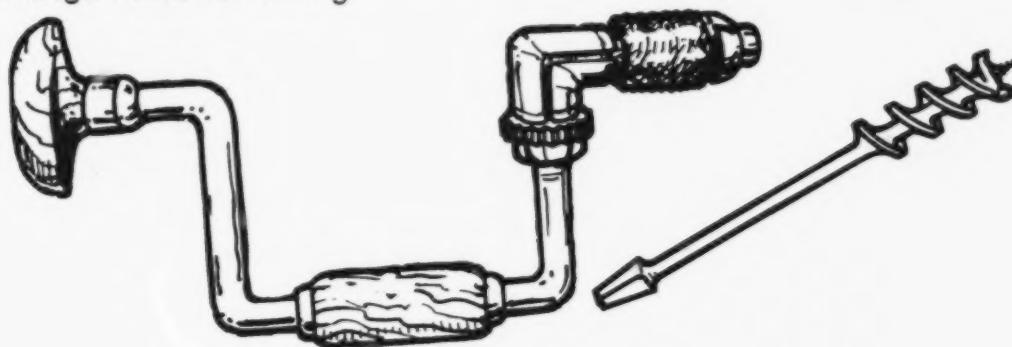
2. Test Light: The test light is used to check for electrical voltage in an outlet.



3. Long Nose Pliers: Long nose pliers are commonly used to bend wires and hold small parts in place.



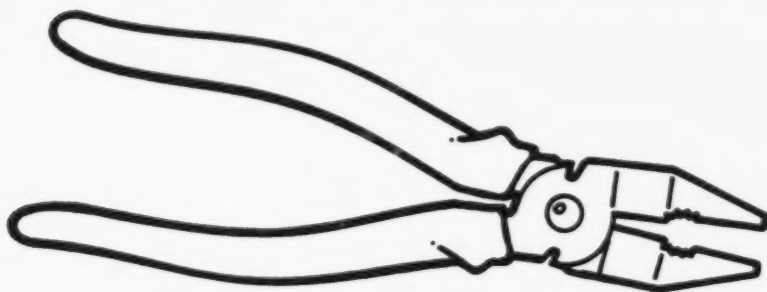
4. Hand Brace and Bit: A hand brace and bit is used to drill and enlarge holes for wiring.



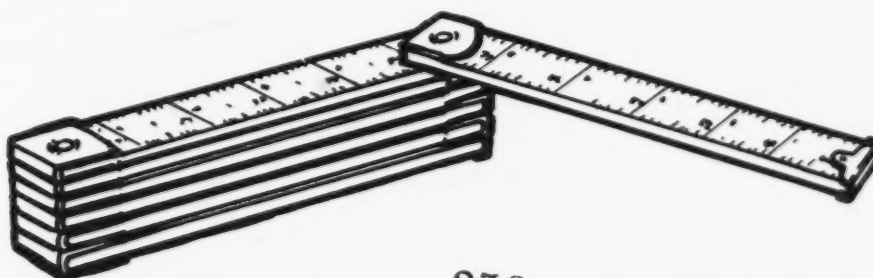
5. Flathead Screwdriver: The flathead screwdriver is used to loosen or tighten flathead screws, install cable connectors, or tighten a connector to the junction box.



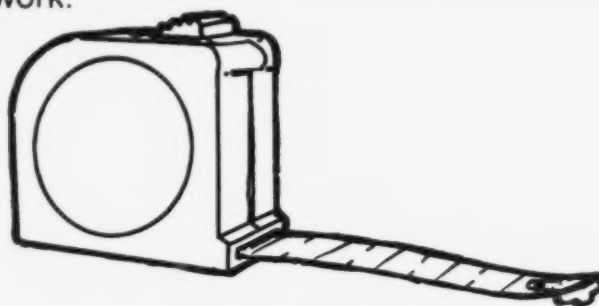
6. Side Cutting Pliers: Side cutting pliers are used to cut electrical wire, twist wires together, and to remove knockouts from boxes.



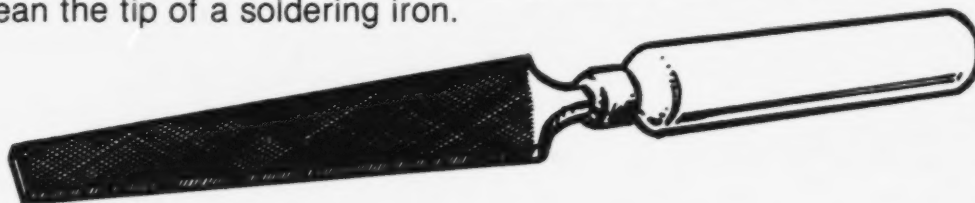
7. Folding Rule: A folding rule is used for measuring and laying out wiring work when a rigid measuring tool is needed.



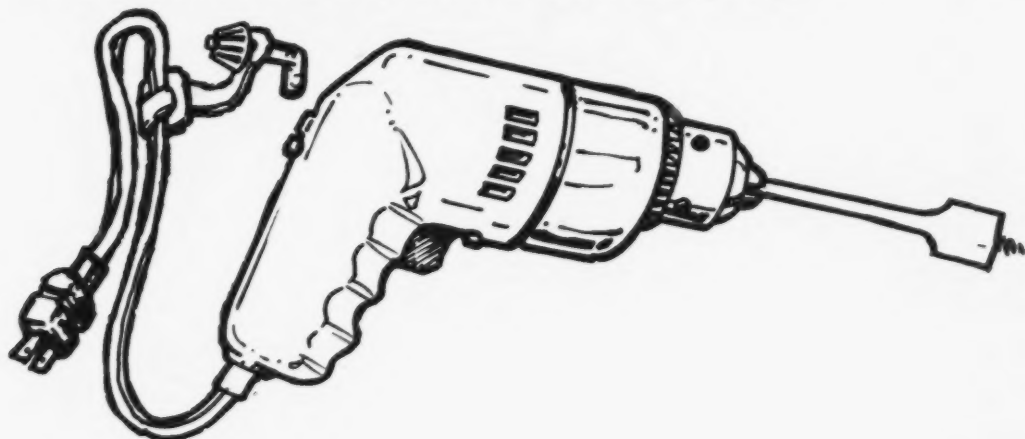
8. Tape Measure: The tape measure is used for measuring and laying out wiring work.



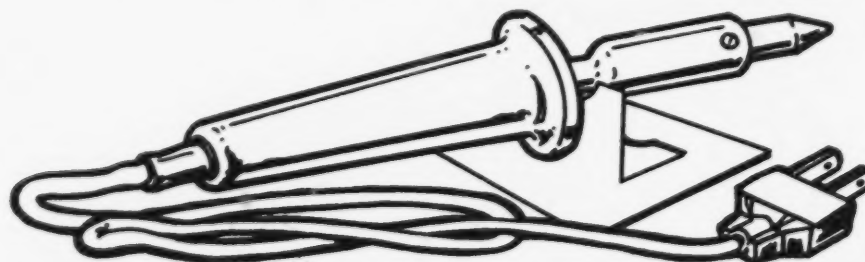
9. File: The file is used to smooth the sharp ends of cut conduit and to clean the tip of a soldering iron.



10. Electric Drill: A portable electric drill (with a spade bit) is used to cut holes in studs and joists for electrical wiring.



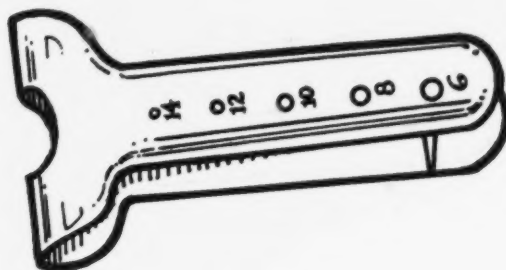
11. Soldering Iron: A soldering iron is used to melt solder for wire splices.



12. Safety Equipment: Safety equipment is worn when doing certain electrical jobs. Equipment is usually safety glasses, gloves, and an apron.



13. Cable Ripper: The cable ripper is used to cut the outside insulation on non-metallic cable.



SEE YOUR INSTRUCTOR

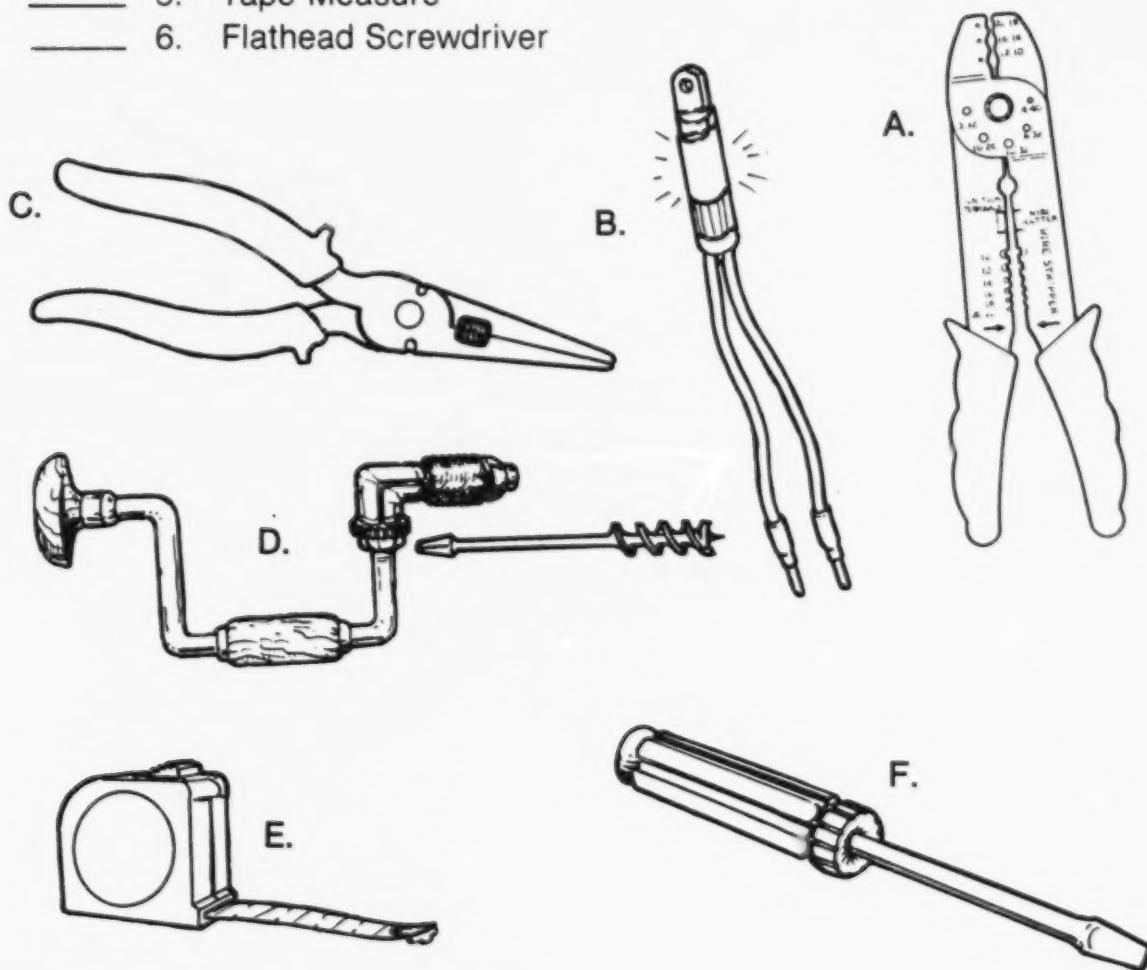
Building Trades - Electrical Construction
Wiring Tools and Their Uses

Unit Review

Name: _____

Directions: Match the following tools with their correct names.

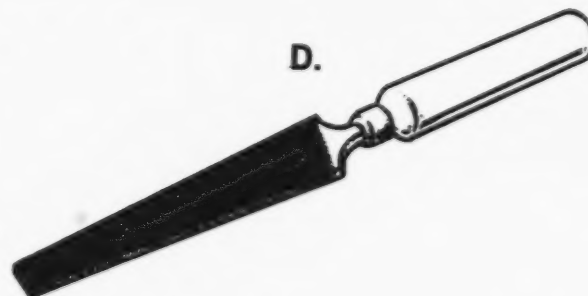
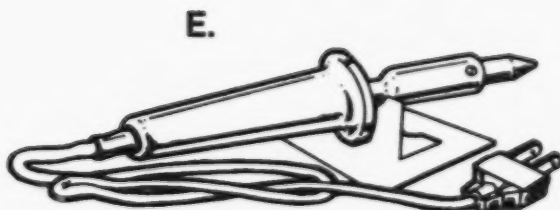
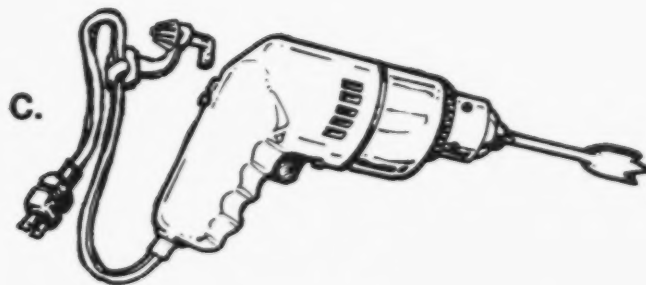
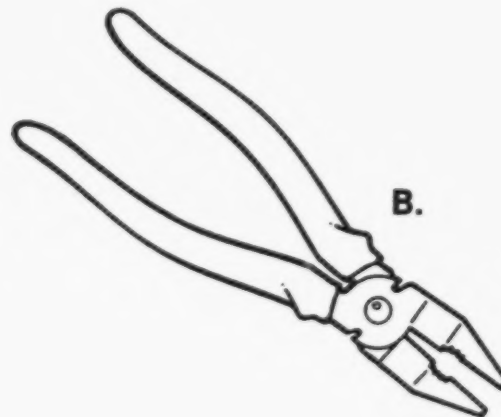
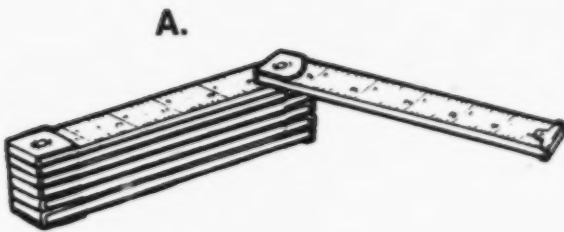
- _____ 1. Wire Stripper/Cutter
- _____ 2. Test Light
- _____ 3. Long Nose Pliers
- _____ 4. Hand Brace and Bit
- _____ 5. Tape Measure
- _____ 6. Flathead Screwdriver



Building Trades - Electrical Construction
Wiring Tools and Their Uses

Directions: Match the following tools with their correct uses.

- _____ 7. Used when rigid measuring device is needed
- _____ 8. Used to smooth sharp ends of conduit
- _____ 9. Used to melt solder for wire splices
- _____ 10. Power tool used to make holes in studs and joists
- _____ 11. Used to cut and twist electrical wires



Building Trades - Electrical Construction
Wiring Tools and Their Uses

Directions: Circle the letter of the best tool for each task:

1. To cut electrical wire and twist wires together:
a. cable ripper b. wire cutter/stripper c. side cutting pliers
2. To check for electric voltage in an outlet:
a. screwdriver b. test light c. long nose pliers
3. To bend wires and hold small parts in place:
a. side cutting pliers b. soldering iron c. long nose pliers
4. To make holes in studs for wiring:
a. brace and bit b. screwdriver c. wire cutter/stripper
5. To slice insulation on non-metallic cable:
a. soldering iron b. cable ripper c. wire cutter/stripper

Building Trades - Electrical Construction
Wiring Tools and Their Uses

Performance Checklist

Student _____ has successfully performed the following steps of procedure.

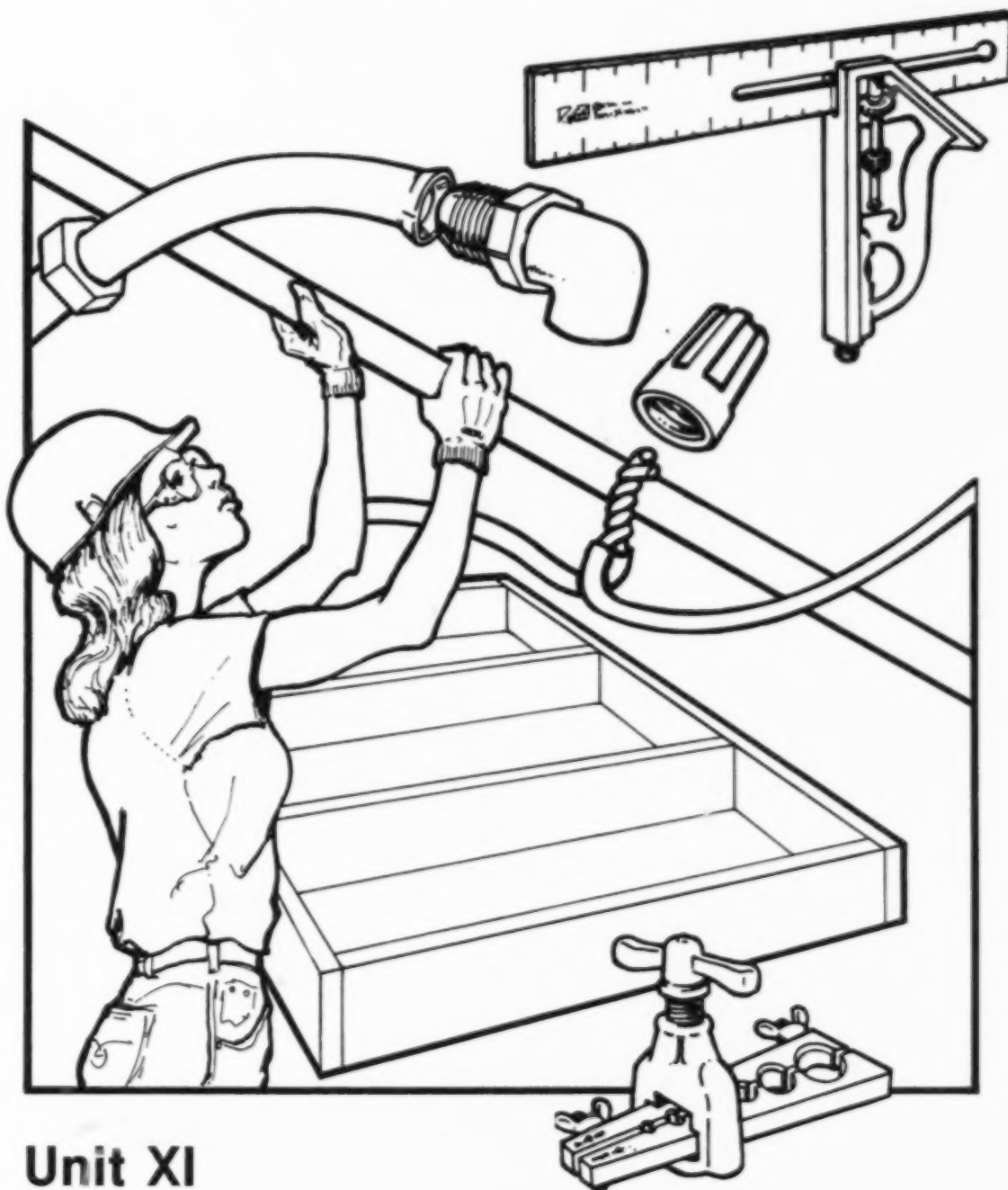
Identifying Wiring Tools and Their Uses	Yes	No	Comments
1. Wire Cutter/Stripper			
2. Test Light			
3. Long Nose Pliers			
4. Handbrace and Bit			
5. Flathead Screwdriver			
6. Side Cutting Pliers			
7. Folding Rule			
8. Tape Measure			
9. File			
10. Electric Drill			
11. Soldering Iron			
12. Safety Equipment			
13. Cable Ripper			

Should Move On ☐

Repeat This Unit ☐

Student's Signature/Date

Instructor's Signature/Date



Unit XI

Electrical Materials

Building Trades - Electrical Construction

Electrical Materials

Electrical Materials

After studying this unit, you will be able to:

1. Identify common electrical wires and cables.
2. Identify common electrical boxes and their uses.
3. Identify common electrical receptacles and their uses.
4. Identify common electrical switches.
5. Identify common electrical connectors and holders.
6. Identify common light fixtures.
7. Identify common household electrical safety devices.
8. Calculate the cost of wire and materials for wiring a room.

Check the Statement that Fits You Best

☐

I can do these tasks and want to go through the Performance Checklist.



SEE YOUR INSTRUCTOR

☐

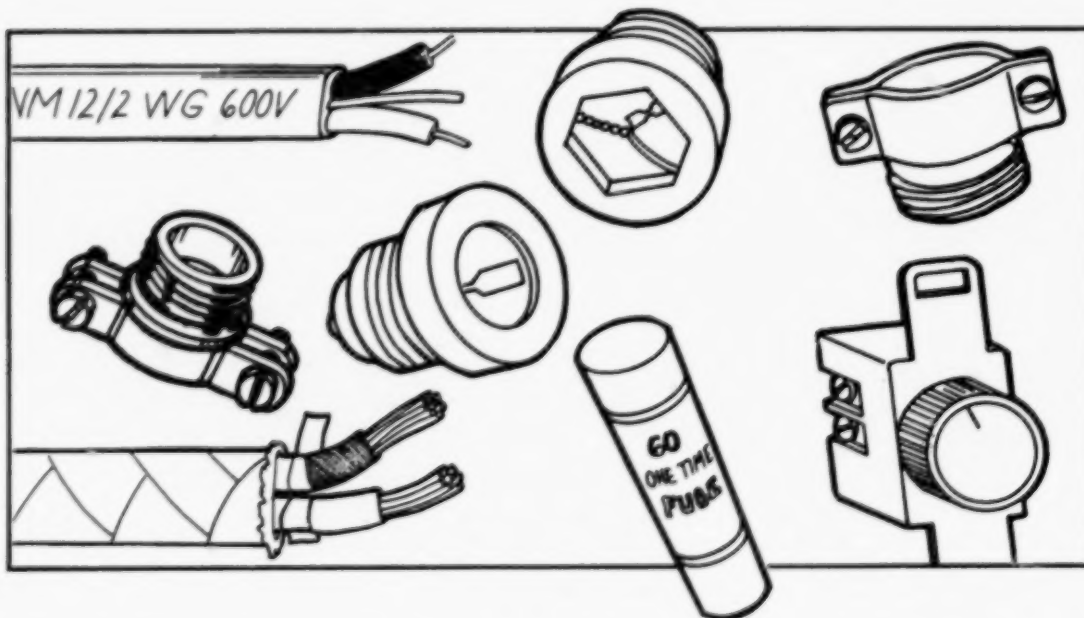
I want to study the information in this unit before I do the Performance Checklist.



TURN PAGE AND BEGIN

Introduction

You have learned about electrical wiring tools and their uses. You must also use certain wires and wiring materials with these tools to do electrical wiring properly and safely. There are many types and brands of materials available and you can become confused if you don't know what is best suited for certain electrical jobs.



In this unit, you will see common types of electrical wires and materials used for wiring and see how they are used.

TURN TO NEXT PAGE

Electrical Materials

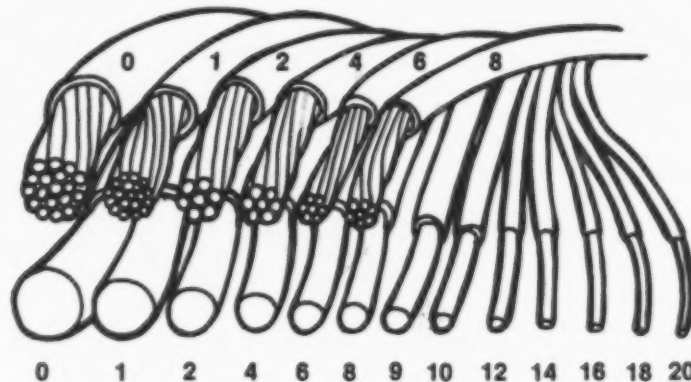
Terms and Definitions

1. Connectors - items used to hold cable or wires together and in place
2. Conductors - materials that allow electrical current to pass through them
3. Current - a movement of electricity in one direction, a flow
4. Device - a unit that carries but does not use current, such as a switch
5. Fixture - electrical equipment fastened to a wall or ceiling
6. Flexible - bends easily
7. Insulate - to cover with a material that does not conduct electricity
8. Octagonal - having eight sides
9. Outlet - a receptacle where electricity can be taken out of the circuit
10. Porcelain - a white fired and glazed type of clay
11. Receptacle - a place that receives the plugs, where you plug in appliances
12. Rectangular - four sided figure
13. Service Entrance - the place where electricity enters a building
14. Standards - codes, sets of rules
15. Utility Company - a company that produces and sells electricity or other community utility (telephone, gas, etc.)

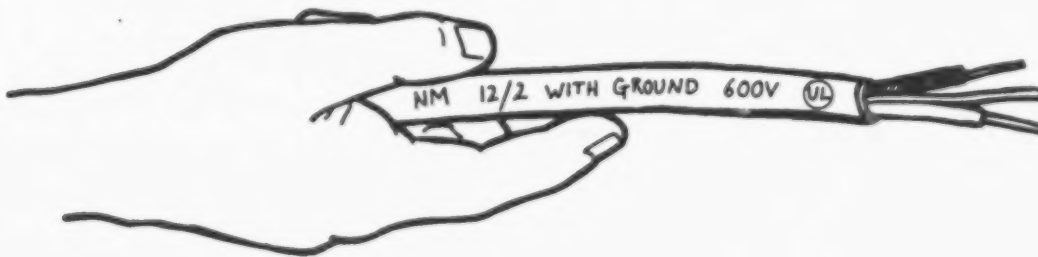
Electrical Materials

A. Electrical Wires

Electrical wires, called conductors, permit electricity to flow through them. Wire conductors can be a single large wire or many small wires together.



Numbers tell the wire size. The bigger the number, the smaller the wire; the smaller the number, the bigger the wire. A number 20 wire for instance is much smaller than a number 8 wire.



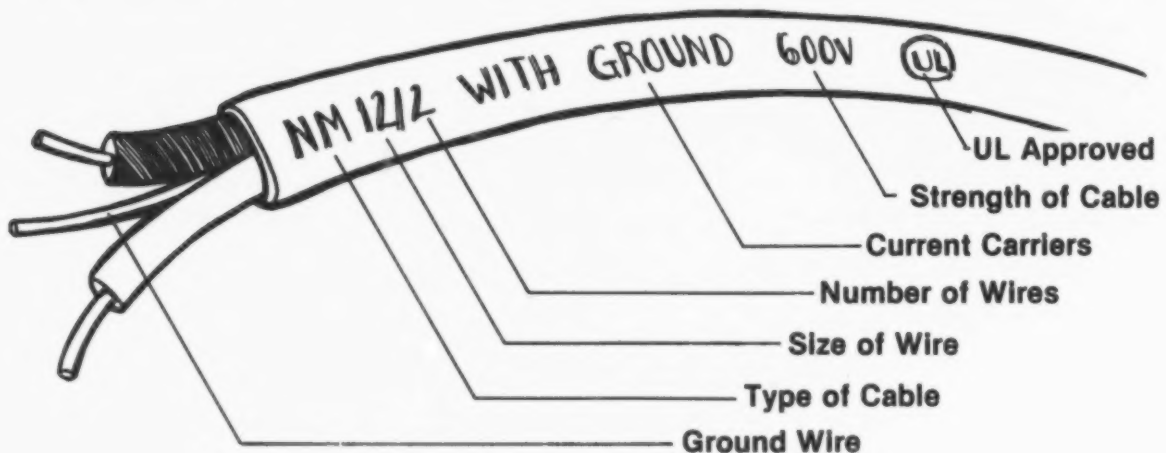
The most commonly used wire in house wiring is a copper wire size number 12.

Size of wiring in houses depends on requirements of the National Electrical Code. This Code sets standards of safety for wiring materials and practices, and requires that they be tested and approved by Underwriters' Laboratories. Approved materials will have a **UL** seal of approval on them.

Electrical Materials

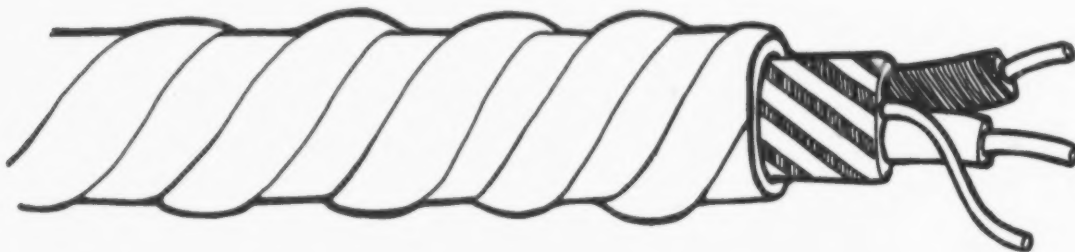
B. Electrical Cables

An electrical cable contains two or more wires. Each current carrying wire has a rubber or plastic covering to insulate and protect it.

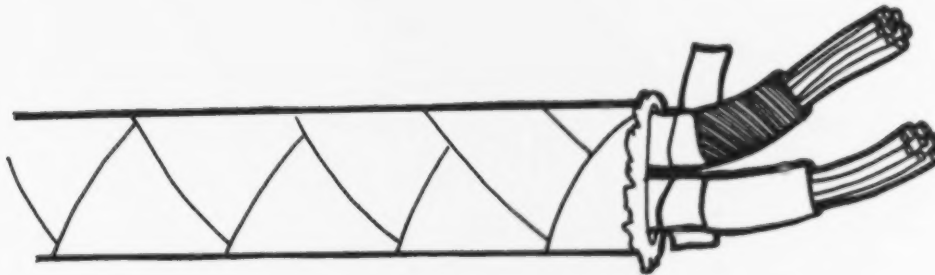


Each electrical cable is marked to show type, size and number of wires, and strength of the cable. Commonly used electrical cables are:

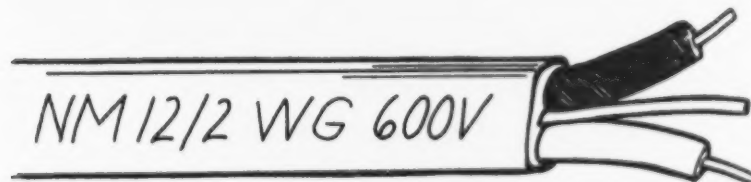
1. Flexible Armored Cable: Cable used in interior work and in places where damage to the wire may occur after installation. Armored cable should not be used in wet places.



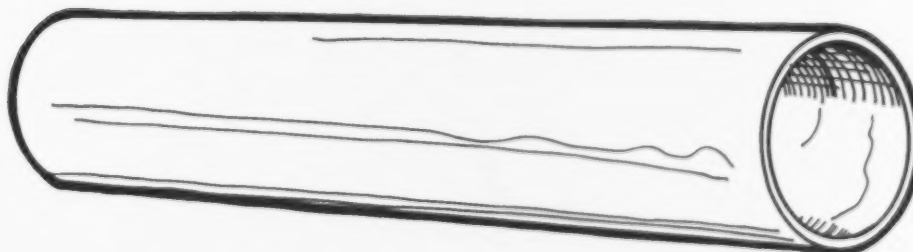
2. Service Entrance Cable: Heavy duty cable used to carry current from the utility pole to the service entrance.



3. Non Metallic (NM) Sheathed Cable: A flat or oval shaped cable used indoors and in dry locations. This cable is easy to work with because of its flexibility.



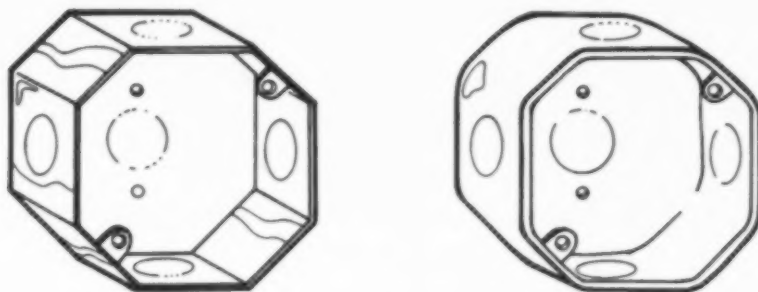
4. Conduit: Not a cable but tubing that provides protection for wires. Conduit may be used outside and is required for outdoor installations.



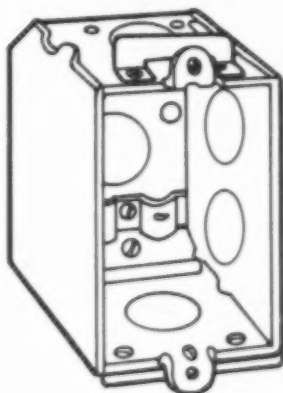
C. Electrical Boxes

Electrical boxes, like wires and cables, serve different purposes and come in many different types. They may be metal or plastic. Check local Code to find out which you should use. The most commonly used boxes include:

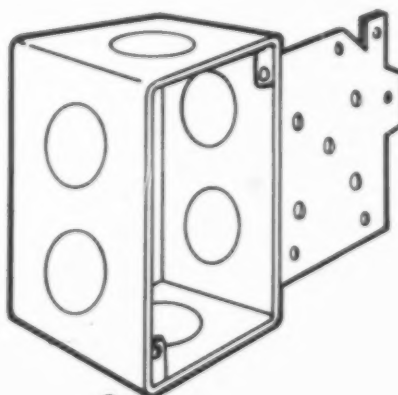
1. Octagonal Box: used to hold ceiling lamps



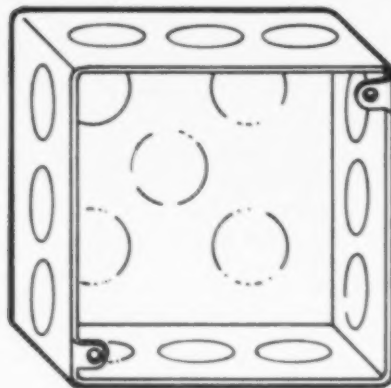
2. Rectangular Box: used for wall switch or outlet receptacle



3. Side Bracket Box: used for switches or receptacles in new buildings

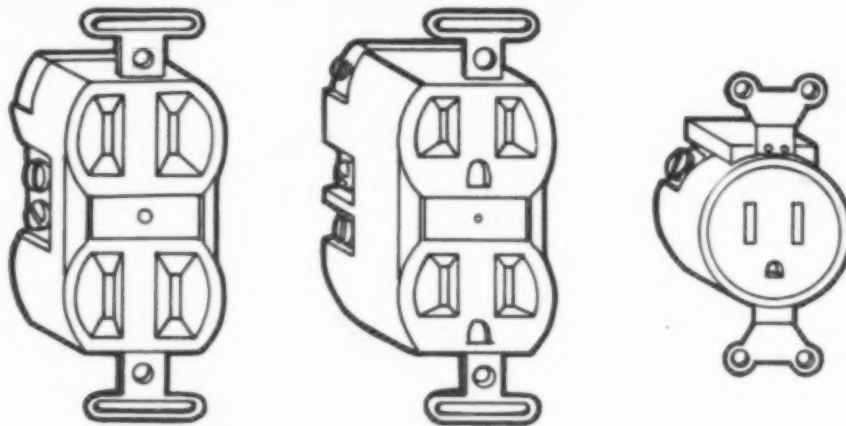


4. Square Box: used to hold more than one outlet or switch

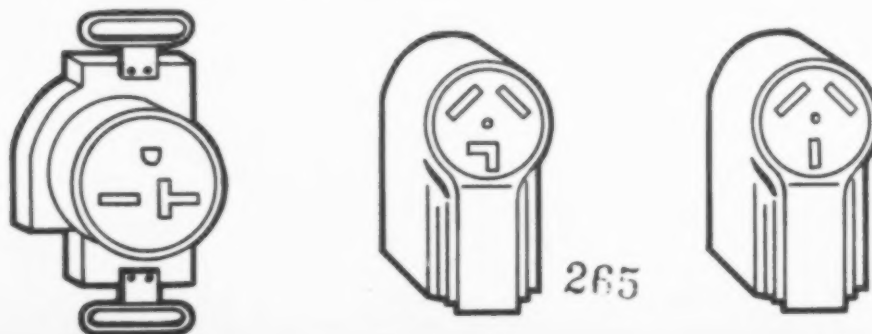


D. Electrical Receptacles

Electrical receptacles provide an outlet for radios, lamps, or other electrical utilities. Receptacles are either two-pronged or three-pronged. Three-pronged receptacles should be used in new construction work for 110 voltage outlets.

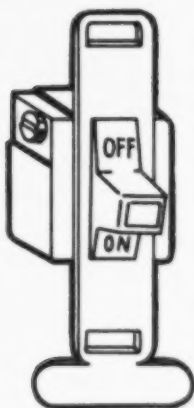


Heavy duty receptacles for higher voltages (220-240) are used for large appliances like dryers or air conditioners. These receptacles have differently shaped plug-in slots.

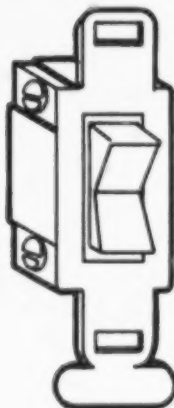


E. Electrical Switches

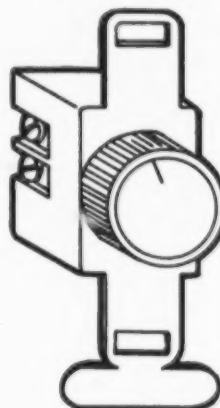
Switches are used to turn the flow of electrical current on or off. Three basic switches are commonly used in new home wiring.



Toggle Switch



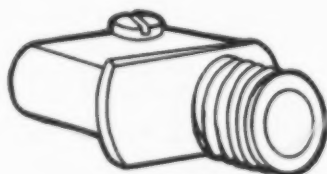
Lever Switch



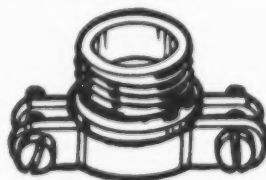
Dimmer Switch

F. Electrical Connectors and Holders

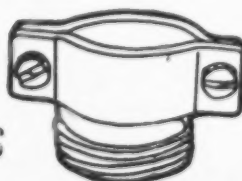
Connectors used to fasten armored cable to the electrical box look like this.



Connectors used to fasten nonmetallic cable to an electrical box look like this.



Connectors used to fasten metal conduit to an electrical box look like this.



Wire nuts are plastic or rubber caps which are screwed over the ends of stripped and twisted wire connections to insulate and protect the wire.



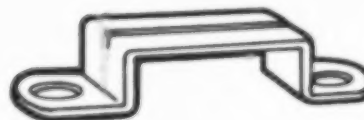
Staples, hangers, and straps are used to hold rigid and flexible cables in place.



Staple



Hanger



Strap

G. Electrical Safety Devices

An electrical safety device is used to prevent electrical wires from overheating and causing fire. Electrical wires overheat when too much current flows through them. The safety device stops the flow of electricity if too much current flows through the wire. The most common electrical safety devices include:

1. Fuse: A fuse burns out when the electrical path it protects is overheated. A burned out fuse must be replaced.



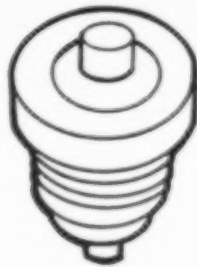
Plug-Type

Time-Delay

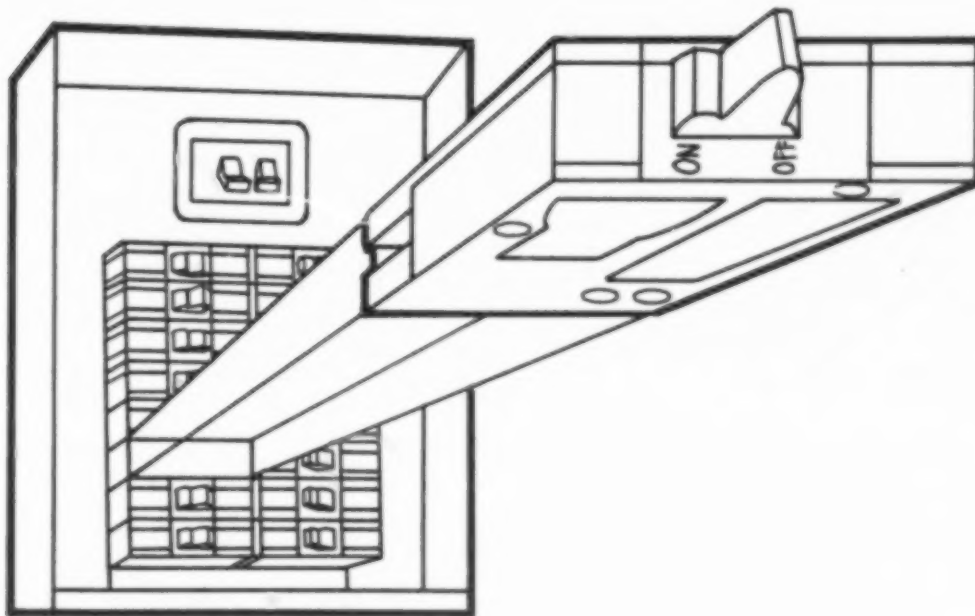
Cartridge Type

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2. Breaker Fuse: A button pops out and breaks the circuit when the circuit overheats on a breaker fuse. To reset, push in the button.



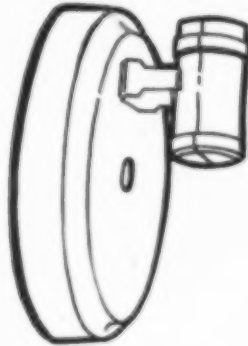
3. Circuit Breaker: A circuit breaker automatically shuts off or 'trips' to break the flow of current when a circuit overheats. It is reset by pushing the switch back to the 'ON' position.



H. Light Fixtures

Light fixtures also come in many sizes and shapes for different uses. They can hold at least one light bulb or fluorescent tube. The most common types are:

1. Wall Fixture: can be installed in a regular outlet box or wall.



2. Porcelain Ceiling Fixture: used in basements or other unfinished parts of a house.



3. Fluorescent Fixture: used in offices and homes because it uses less electricity than bulb fixtures



Electrical Materials

Skill Sheet One Calculating Cost of Materials

Electrical workers must be able to figure the cost of the materials needed to do a job. Look at this sample problem.

The electrician had to install a new circuit on a porch. It required 2 receptacles, 2 outlet covers, an octagon box, a porcelain fixture, a switch, a switch plate, 3 rectangular boxes, six connectors and 25 feet of cable.

The electrician looked up the following prices:

receptacles	\$1.39 ea.
outlet cover	\$.39 ea.
octagon box	\$1.29 ea.
porcelain fixture	\$2.79 ea.
toggle switch	\$1.19 ea.
switch plate	\$.39 ea.
rectangular boxes	\$.89 ea.
connector	\$.25 ea.
cable	\$.15/ft.

The electrician then used a worksheet to figure costs:

receptacles	2 x 1.39	=	\$2.78
outlet covers	2 x .39	=	\$.78
octagon box	2 x 1.29	=	\$1.29
porcelain fixture	1 x 2.79	=	\$2.79
toggle switch	1 x 1.19	=	\$1.19
rectangular box	3 x .89	=	\$2.67
connectors	6 x .25	=	\$1.50
cable	25 x .15	=	\$3.45

The costs were added to give the electrician the cost of materials for the job.

$$\begin{array}{r}
 \$2.78 + .78 \\
 + 1.29 + 2.79 \\
 + 1.19 + 2.67 \\
 + 1.50 + 3.45 \\
 \hline
 = \$16.45 \text{ Total}
 \end{array}$$

Use the following prices to calculate the cost of materials:

cable	\$.14 a foot
connector	\$.25 ea.
duplex receptacle	\$1.39 ea.
rectangular box	\$.89 ea.
cover plate	\$.39 ea.
15 ampere circuit breaker	\$19.87 ea.
switch	\$1.39 ea.
porcelain fixture	\$2.79 ea.
octagon box	\$1.29 ea.
wire nut	\$.07 ea.

Problem 1: What would be the cost of adding an outlet to a circuit if you need the following materials?

16 feet of cable	_____ x _____ = _____
2 romex connectors	_____ x _____ = _____
1 duplex receptacle	_____ x _____ = _____
1 rectangular box	_____ x _____ = _____
1 cover plate	_____ x _____ = _____
Total	= _____

Problem 2: What would the materials cost for this job?

15 ampere circuit breaker	_____ x _____ = _____
80 ft of cable	_____ x _____ = _____
2 switches	_____ x _____ = _____
4 receptacles	_____ x _____ = _____
2 porcelain fixtures	_____ x _____ = _____
2 octagon boxes	_____ x _____ = _____
6 rectangular boxes	_____ x _____ = _____
16 romex connectors	_____ x _____ = _____
8 wire nuts	_____ x _____ = _____
6 cover plates	_____ x _____ = _____
Total	= _____

Problem 3: What is the cost of materials for this job?

Replace 4 porcelain fixtures	_____ x _____ = _____
Replace 2 switches	_____ x _____ = _____
Total	= _____

Building Trades - Electrical Construction
Electrical Materials

Skill Sheet Two
Calculating Cost of Wire Per Foot

To figure the cost per foot divide the cost by the number of feet.

Example: Baker Electric Supply sells 100' rolls of 14-2 with ground cable for \$8.99.

$$\begin{array}{r} .089 \\ 100 \overline{) 8.99} \\ \underline{8.00} \\ .990 \\ \underline{.900} \end{array}$$

Your cost is almost \$.09 per foot.

Figure the cost of one foot of wire for each of the following problems:
[Round off the answer to the next higher cent ($8\frac{1}{2}$ to 9).]

1. 14-2 indoor cable with ground

25'	\$2.39	1 ft = ____
50'	\$4.59	1 ft = ____
100'	\$7.95	1 ft = ____
250'	\$15.00	1 ft = ____
2. 12-2 indoor cable with ground

25'	\$2.96	1 ft = ____
50'	\$5.73	1 ft = ____
100'	\$11.23	1 ft = ____
250'	\$21.95	1 ft = ____
3. UL Listed Outdoor 14-2 wire

25'	\$2.99	1 ft = ____
50'	\$5.89	1 ft = ____
100'	\$11.76	1 ft = ____
250'	\$21.95	1 ft = ____
4. UL Listed Outdoor 12-2 wire

25'	\$3.99	1 ft = ____
50'	\$7.88	1 ft = ____
100'	\$15.67	1 ft = ____
250'	\$28.67	1 ft = ____

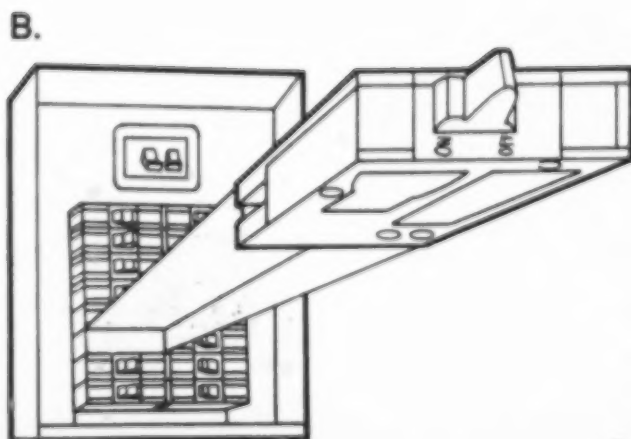
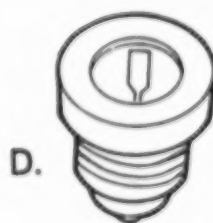
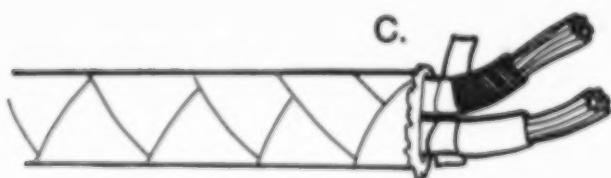
Building Trades - Electrical Construction
Electrical Materials

Unit Review

Name: _____

Match the names with the correct objects.

- _____ 1. Service Entrance Cable
- _____ 2. Nonmetallic Sheathed Cable
- _____ 3. Light Fixture
- _____ 4. Light Switch
- _____ 5. Fuse
- _____ 6. Circuit Breaker

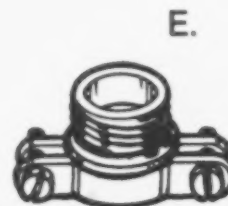
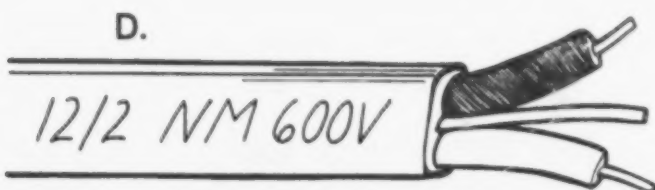
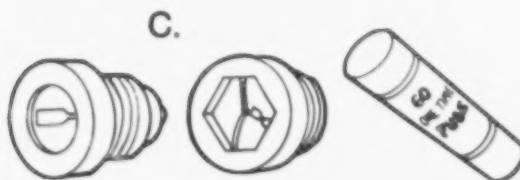
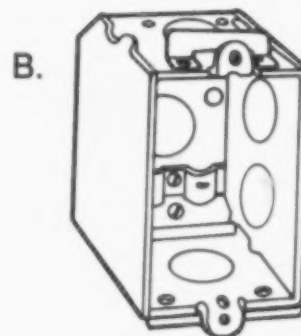
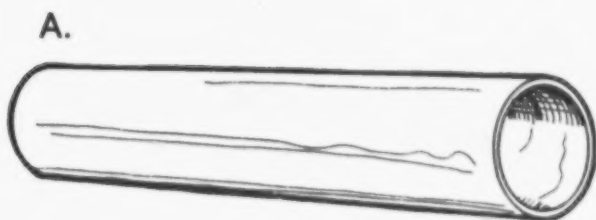


Electrical Materials

Name: _____

Match the objects with their correct uses.

- _____ 7. Box used for a switch or receptacle and its wiring connections.
- _____ 8. A safety device which stops the flow of electricity when a circuit overheats.
- _____ 9. Device used to hold non metallic cable to a junction box.
- _____ 10. Tubing that is used to protect electrical wiring.
- _____ 11. Cable for indoor and dry location use.



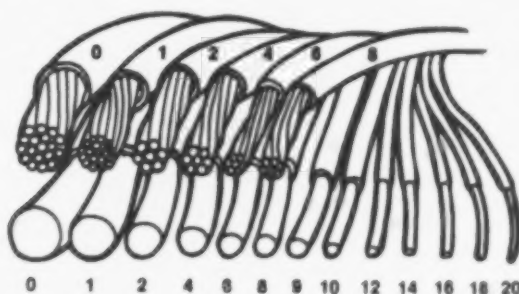
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Electrical Materials

Name: _____

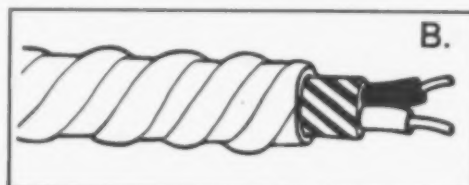
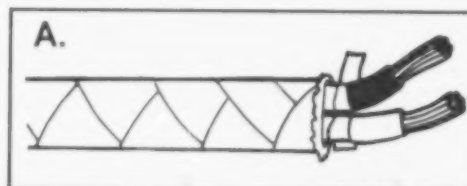
Using What You Have Learned

12. Circle the number indicating the most common size of wire used in house wiring.



Match the cable with its correct name.

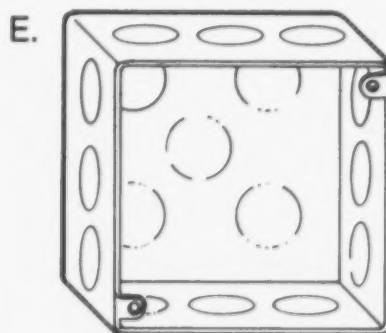
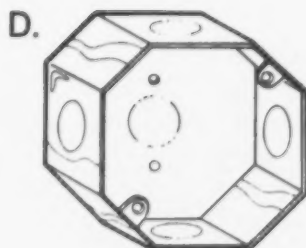
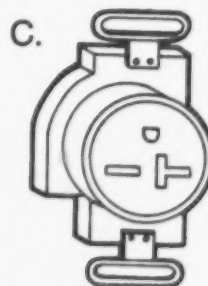
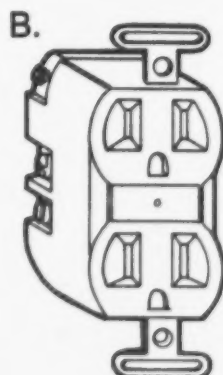
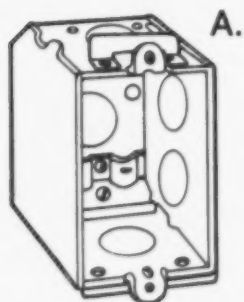
- ___ 13. Non Metallic Sheathed Cable
- ___ 14. Flexible Armored Cable
- ___ 15. Service Entrance Cable



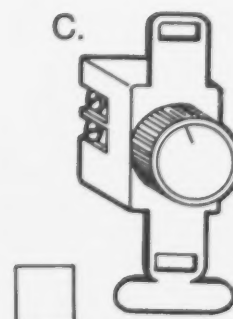
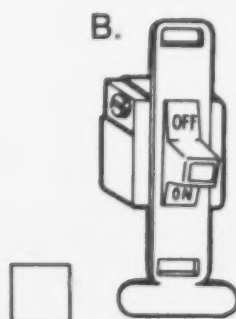
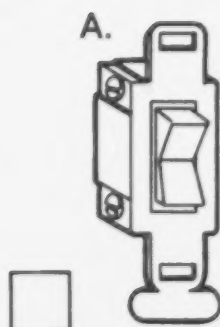
16. Draw an arrow pointing to the ground wire in the NM sheath cable above.

Match each object with what it does.

- ___ 17. Octagonal shaped box for ceiling lamps
- ___ 18. Rectangular box used for wall switches or outlets
- ___ 19. Square box for more than one outlet or switch
- ___ 20. Common receptacle for 110 voltage (AM radio)
- ___ 21. Common receptacle for 220 voltage (clothes dryer)



22. Check the box next to the toggle switch.



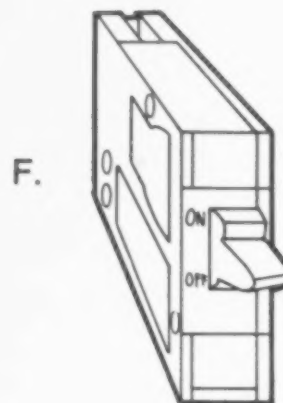
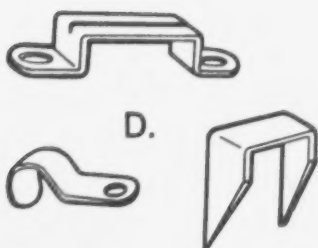
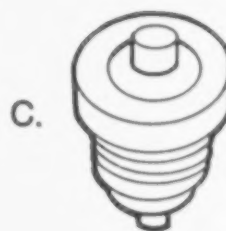
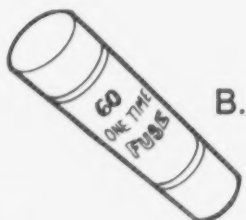
276

23. Check the most common NM cable connector.



Match the picture to its purpose or job.

- ___ 24. Plastic caps used to insulate and protect wire splices
- ___ 25. Used to hold electrical cables in position
- ___ 26. Electrical safety device which burns out when overheated
- ___ 27. Safety device with a button that pops out to break the circuit when it becomes overheated
- ___ 28. An electrical safety device that 'trips' when overheated and can be reset
- ___ 29. Lighting fixture used because it used less electricity than standard bulb fixture.



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Building Trades - Electrical Construction

Electrical Materials

Performance Checklist

Student _____ has successfully performed the following steps of procedure.

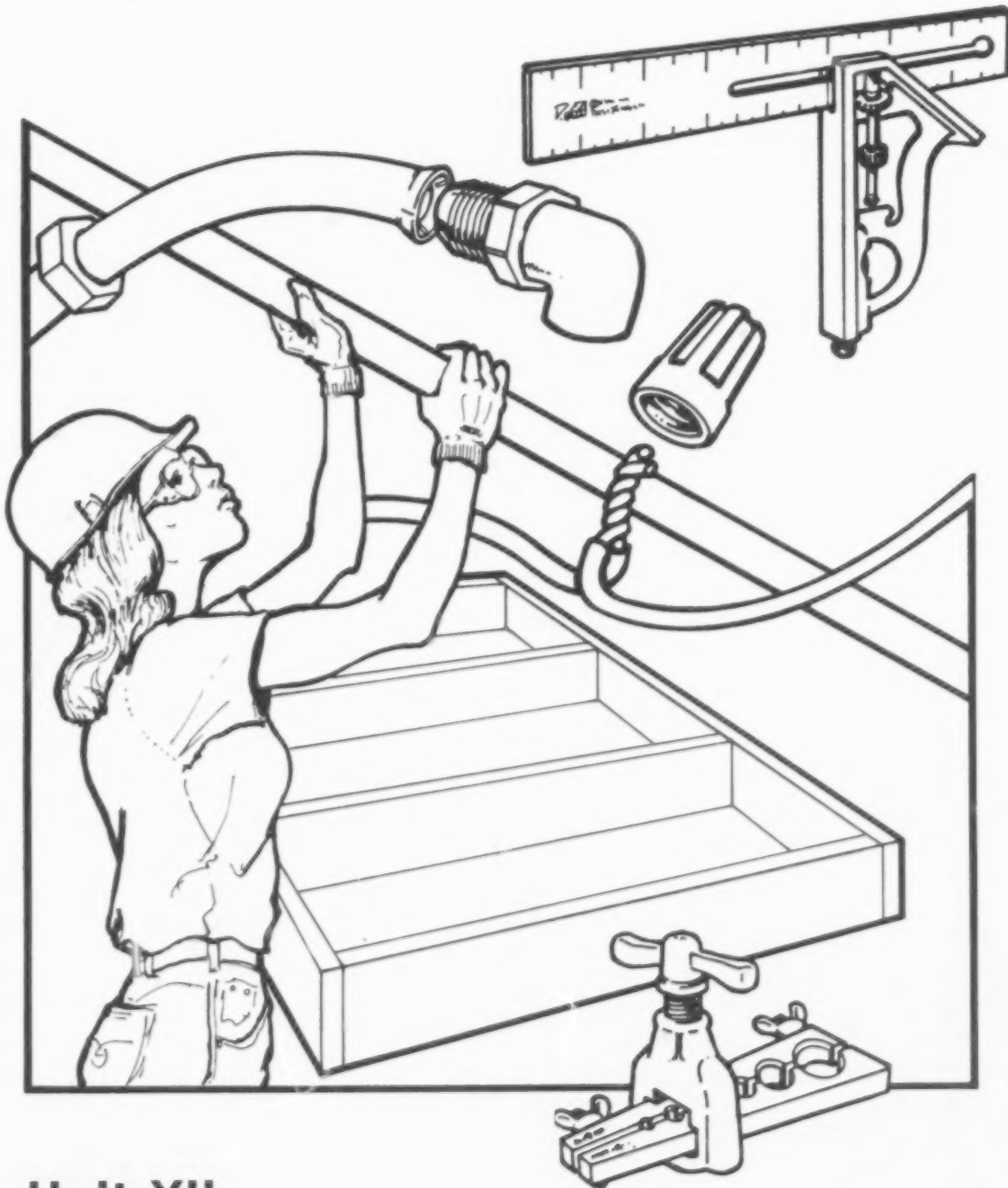
Electrical Wires	Yes	No	Comments
1. Identified and understood wire sizes			
2. Identified and understood cable types and sizes			
3. Identified common electrical boxes			
4. Identified common electrical receptacles			
5. Identified common electrical switches			
6. Identified common electrical holders and connectors			
7. Identified common electrical safety devices			
8. Identified common lighting fixtures			
9. Accurately calculated cost of electrical materials			
10. Accurately calculated per foot cost of wire			

Should Move On ☐

Repeat This Unit ☐

Student Signature/Date

Instructor Signature/Date



Unit XII

Safety Rules in Electrical Wiring

Building Trades - Electrical Construction

Safety Rules in Electrical Wiring

Safety Rules in Electrical Wiring

After studying this unit, you will be able to:

1. Identify safe wiring practices for the worker.
2. Identify how electricity works and use a formula to determine safe loads.

Check the Statement that Fits You Best

☐

I can do these tasks and want to go through the Performance Checklist.



SEE YOUR INSTRUCTOR

☐

I want to study the information in this unit before I do the Performance Checklist.



TURN PAGE AND BEGIN

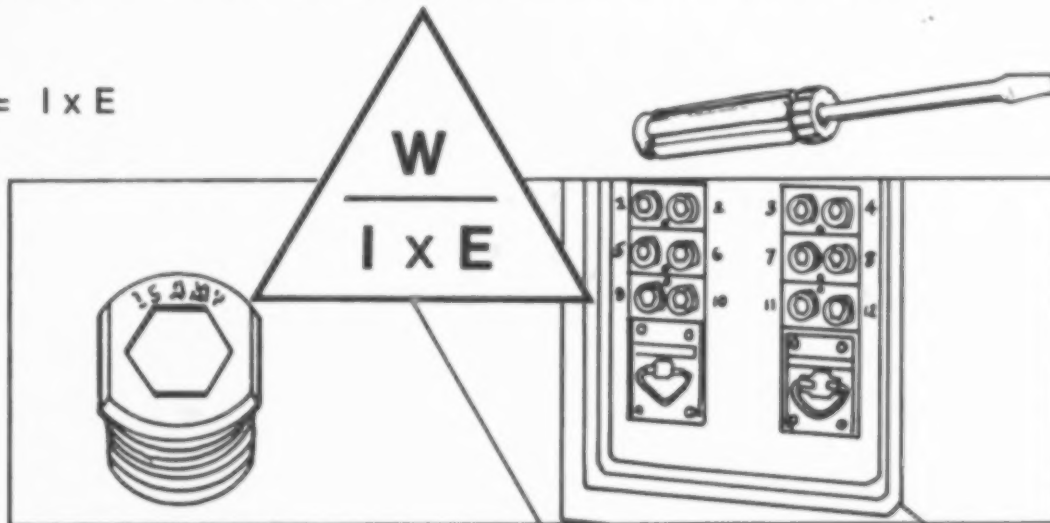
Building Trades - Electrical Construction

Safety Rules in Electrical Wiring

Introduction

Electricity is useful but it can be dangerous. It can kill you or burn down the house, right? True, but if you learn how electricity works and follow safety rules and take precautions, you will have no danger. Electrical accidents can be prevented if workers follow safety precautions, and understand how electricity works, and follow the electrical code.

$$W = I \times E$$



You must always be concerned with safety when working with electricity. Your life depends on it. Be sure to follow the rules and precautions that make you a safe electrical worker.

In this unit you will learn how electricity works and safety rules you must follow while working with electricity.

1. Never work on an electrical path or circuit until you have disconnected the power.
2. Never touch any electrical wire until you have made sure it is not a live wire.
5. Never install a larger capacity fuse than is needed. Never install a larger capacity circuit breaker than is needed.

TURN TO NEXT PAGE

Building Trades - Electrical Construction

Safety Rules in Electrical Wiring

A. Terms and Definitions

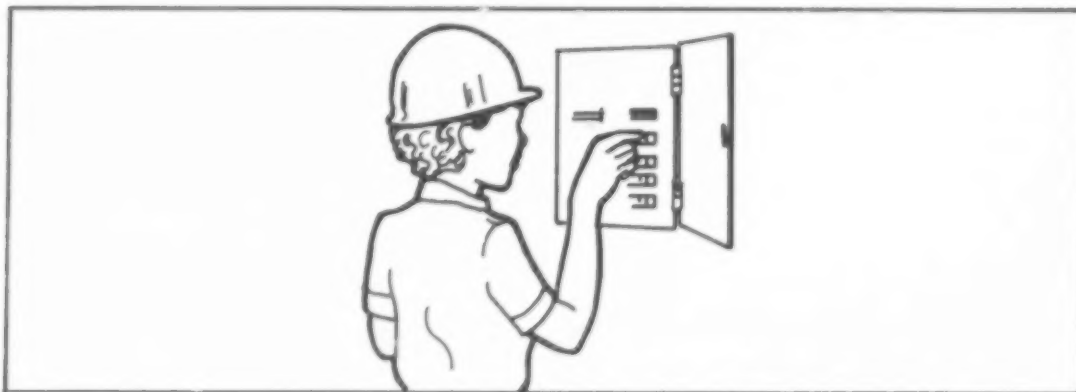
1. Amperes (amp) - a measure of the amount or rate of electric current flow
2. Bare Wire - wire with no insulation covering the wire
3. Circuit - The path of electric current from the source to power user (lights) and back to the source
4. Code - a set of rules to protect people and buildings from the danger due to the use of electricity
5. Conduct - allow electric current to flow through
6. Disconnect - to turn off power or take apart
7. Ground Wire - the wire in a cable that carries no current which is used for safety
8. Junction - where conductors (wires) are joined together
9. Live Wire - a wire that carries current
10. Ohm - the amount of electrical friction or resistance
11. Overload - current demand exceeds that for which the circuit was designed
12. Source - place where power begins or comes from
13. Precaution - care taken before you start
14. Volts - the amount of pressure that moves electricity through the wires
15. Watts - the amount of power being used

Building Trades - Electrical Construction

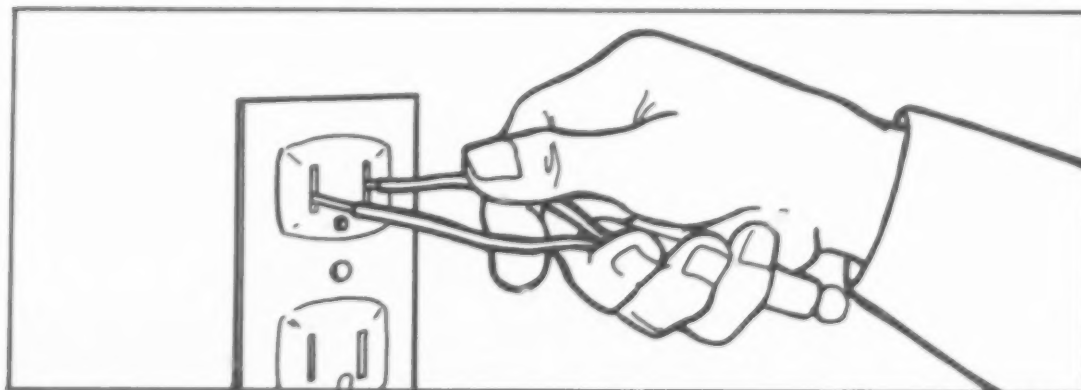
Safety Rules in Electrical Wiring

Safety Rules in Electrical Wiring

1. Never work on an electrical path or circuit until you have disconnected the power.



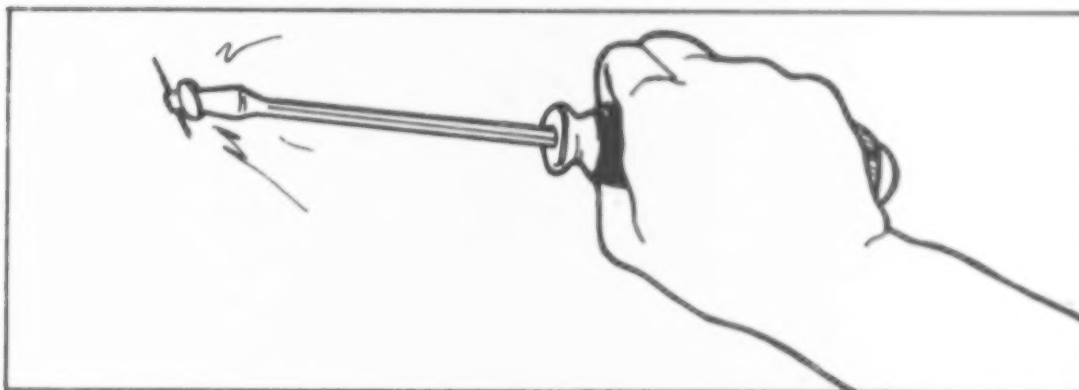
2. Never touch any electrical wire until you have made sure it is not a live wire.



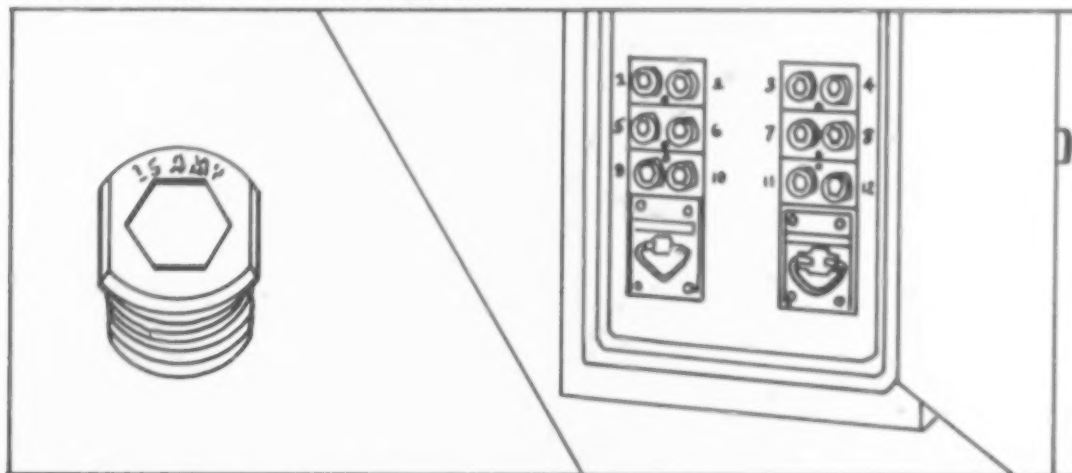
3. Always wear safety glasses when cutting, stripping, and installing electrical wiring.



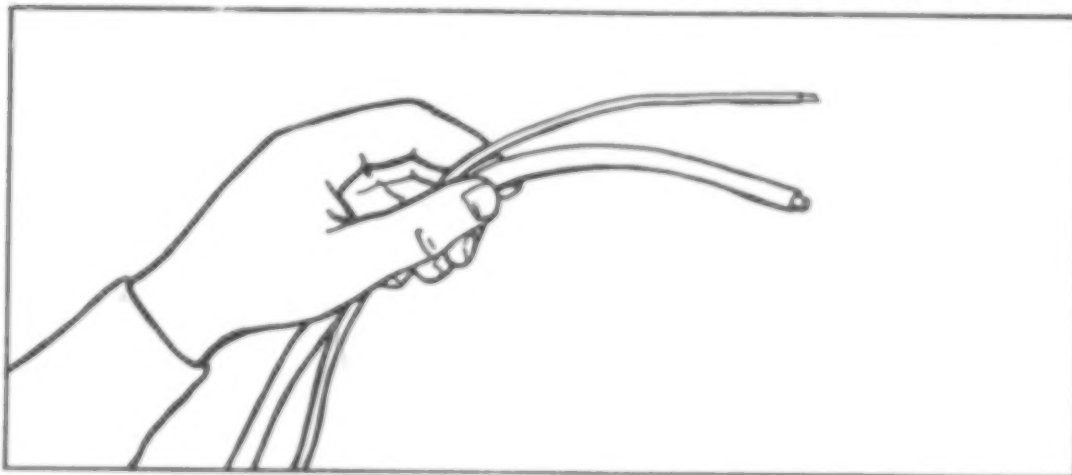
4. Always use tools that have insulated handles. Insulated handles protect you from electrical shock.



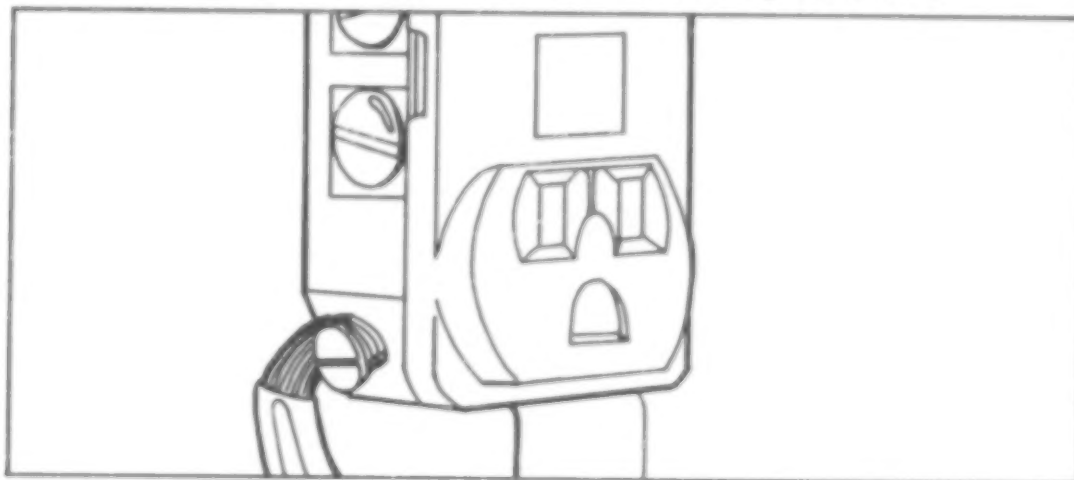
5. Never install a larger fuse than is needed. Never install a larger circuit breaker than is needed.



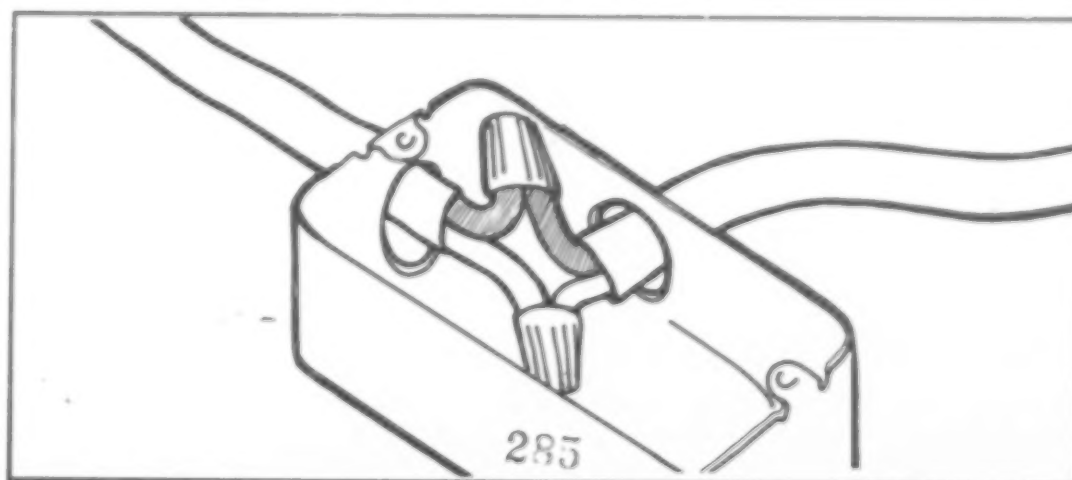
6. Select proper wire for a job. Too small of a wire may cause a fire.



7. Never install a three prong receptacle without a ground wire.



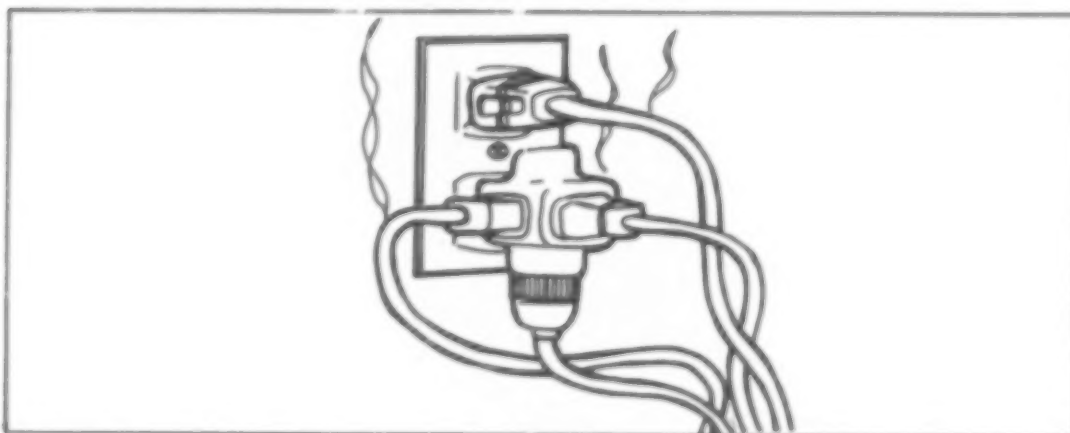
8. Make all splices or connections in a junction box.



9. Always follow the electrical code for your area.



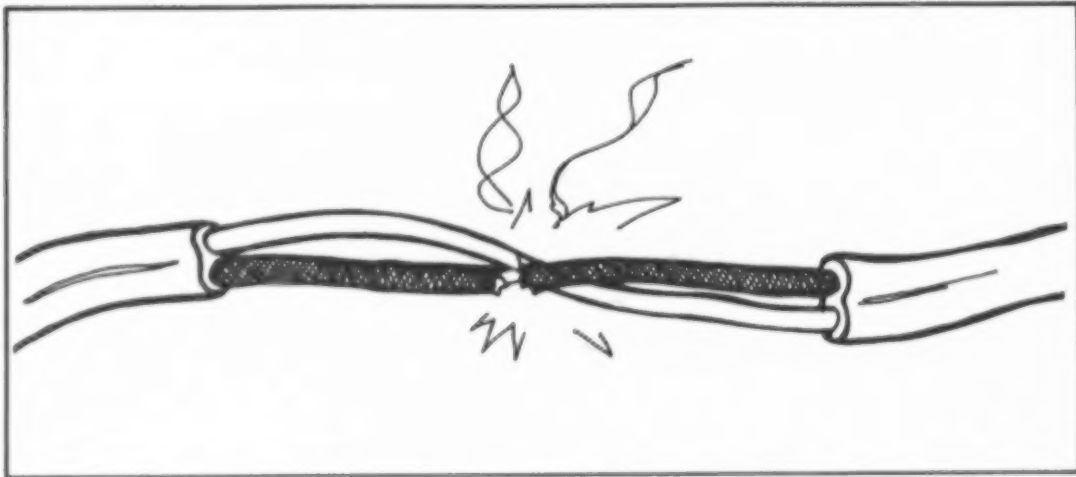
10. Never overload a circuit with too many appliances. The wires may overheat and cause a fire.



11. Always ask questions about anything you do not fully understand.



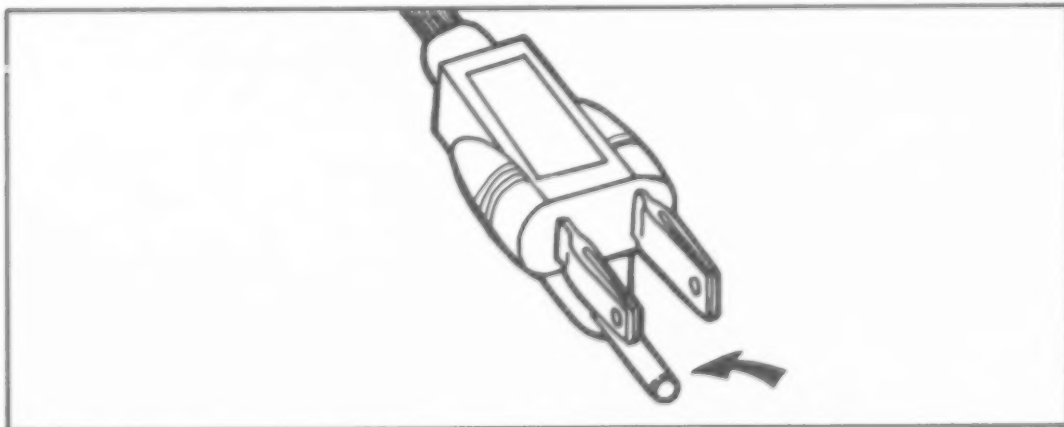
12. Never allow bare wires carrying current to touch. A fire may result.



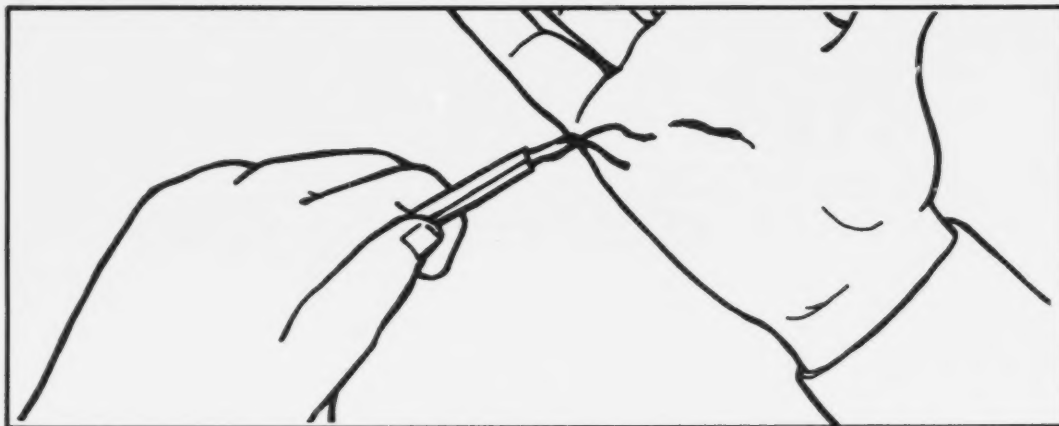
13. Always report accidents to your instructor no matter how small they seem to be.



14. Never cut off the grounded prong of an electrical plug. The ground makes appliances and power safer to use.



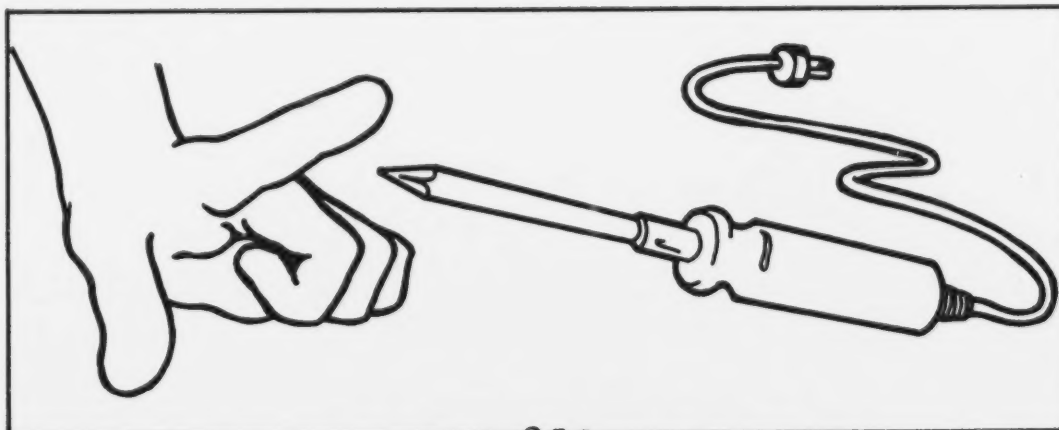
15. Always handle bare wires carefully because their sharp ends may cut or scratch you.



16. Never switch an electrical device off or on while you are wet or standing in water. Water conducts electrical current.



17. Never touch the tip of a soldering iron because you may burn yourself.



18. Always check your work carefully before connecting it to a power source. Have your supervisor or instructor check it also.



19. Always make sure that you know what you are doing when working with electricity. You might not get a second chance!



Building Trades - Electrical Construction

Safety Rules in Electrical Wiring

How Electricity Works

Electricity flows much like water flowing through a hose. The electricity must be contained in a wire. The moving electricity creates a current called Amperes. The pressure that pushes the electricity is Voltage. If you multiply Amperes times Voltage, you get Watts. Watts tell you how much energy is being used.

It is important to understand these three measurements of electricity:

Amperes: often called amps, measures how many electrons flow past a point in one second. One ampere requires more than six billion electrons.

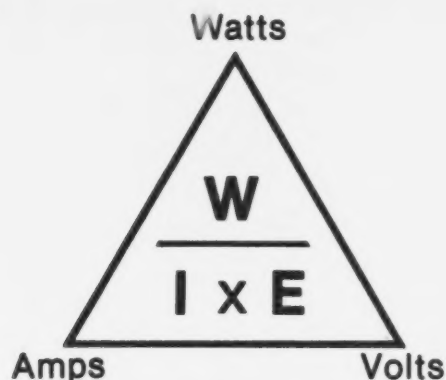
Volts: tell you how much pressure there is being used to push the electricity through the wires. Since voltage meets resistance in wires, a longer wire has more resistance which causes a drop in voltage. Electricity in the National Electric Code is figured on the basis of 115 and 230 volts. Many electricians use the figures 120 or 240 volts.

Watts: tell you how much power is being used. $\text{Amps} \times \text{Volts} = \text{Watts}$. The number of watts per hour tells you how much electricity an appliance is using.

Voltage and Amperage, or Wattage, requirements are marked on every electrical device and appliance. That information helps the worker determine how many circuits are needed, what size wiring to use and what size circuit breakers or fuses to use.

One Volt pressure is needed to push one Ampere through one Ohm of resistance. This formula shows how Watts, Volts and Amperes are related.

Cover what you want to find. If you want to find Volts, cover E. You see that you must divide the amps into the watts. $E = W/I$.



Here is a sample problem:

You have 115 volt service with a 15 amp fuse. How many watts can you get?

- a. Cover **W** on the triangle.
- b. Write the formula. $W = I \times E$.
- c. Put in the numbers. $W = 15 \times 115$.
- d. Multiply to determine Watts. $W = 15(115) = 1725 \text{ W}$.

Now you try this one. Remember to follow the steps. You have 115 volt service with a 20 amp fuse. How many watts can you get?

Did your formula look like this?

$$W = I \times E$$

When you put in the numbers, did it look like this?

$$W = 20 \times 115$$

Your answer should look like this:

$$W = 2300$$

Electricians must calculate things they do not know based on information they do have. They must use the simple formulas shown in the triangle.

$$W = I \times E, I = W/E, E = I/W$$

Try one more. you know that a circuit will need 2070 watts. You know that you have 115 volt service. Will you need a 15 amp fuse or a 20 amp fuse?

Did your work look like this?

$$I = W/E$$

$$I = 2070/115$$

$$I = 18$$

A 15 amp fuse would be too small. You need a 20 amp fuse.

Building Trades - Electrical Construction
Safety Rules in Electrical Wiring

Skill Sheet 1

Calculating Watts, Volts, and Amperes

Use the formula to help you calculate the answers.

1. You have 1800 watts. You have 120 volts. How many
amps? _____
2. You have 120 volt service with a 20 amp fuse. How many
watts? _____
3. You have 115 volt service (figure used in the Electrical Code) and a
15 amp fuse. How many watts? _____
4. You have 2070 watts and 115 volt service. How many
amps? _____
5. You have 15 amps and 1800 watts. How many volts? _____
6. You have 15 amps and 1725 watts. How many volts? _____

Building Trades - Electrical Construction
Safety Rules in Electrical Wiring

Skill Sheet 2

Name: _____

Using What You Have Learned

Circle 'T' if the statement is true, or 'F' if the statement is false.

- | | | |
|---|---|---|
| T | F | 1. Overloading a circuit can cause a fire. |
| T | F | 2. A fire may start when bare parts of wires touch when they are carrying electricity. |
| T | F | 3. It is important that you report accidents to your instructor, no matter how small they seem to be at the time. |
| T | F | 4. The ends of bare wires should not be handled carelessly. |
| T | F | 5. It is safe to do electrical hookups while standing in water or on a damp floor. |
| T | F | 6. Grounded plugs are safer to use than ungrounded ones. |
| T | F | 7. Insulated handles on tools help to prevent electrical shock. |
| T | F | 8. You can usually do electrical wiring tasks even if you have some questions about how the job is done. |
| T | F | 9. You can check an electrical wire with a test light to find out whether it has current or not. |
| T | F | 10. Never work on an electrical circuit until you have found and disconnected the main circuit breaker. |
| T | F | 11. Safety glasses protect your eyes when cutting, stripping, and installing wiring. |
| T | F | 12. If a circuit requires a 15 amp fuse, you may safely put in a larger size. |
| T | F | 13. Different wire sizes have different uses. |
| T | F | 14. A three prong receptacle without a ground wire attached is as safe as one with a ground wire attached. |
| T | F | 15. Splices can be made safely anywhere along a circuit without a junction box. |
| T | F | 16. It is important to check electrical work carefully before connecting it to the power source. |

Building Trades - Electrical Construction
Safety Rules in Electrical Wiring

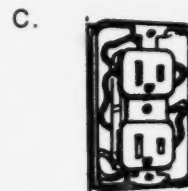
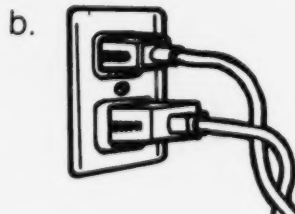
Unit Review

1. You should wear safety glasses when:
 - a. cutting wiring
 - b. stripping and installing wiring
 - c. both a and b
2. Tool handles should be:
 - a. insulated
 - b. steel
 - c. aluminum
3. The first thing you should do when working with electricity is:
 - a. test for live wires
 - b. disconnect the power
 - c. install the right size fuse
4. Never install a three prong receptacle without:
 - a. soldered splices
 - b. a ground wire
 - c. armored cable
5. Which wire could cause a fire when connected to #14 wire?
 - a. #14 wire
 - b. #12 wire
 - c. #18 wire

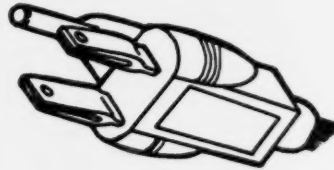
6. Which picture shows a proper connection?



7. Identify the safe receptacle:

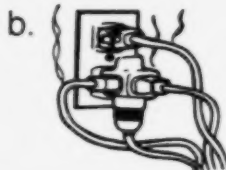


8. A set of rules you must use for safe wiring is:
 - a. electrical code
 - b. U. L. listings
 - c. Ohm's laws
9. The best procedure to follow when you are not sure is:
 - a. use the trial and error method
 - b. ask you supervisor
 - c. not do the task at all
10. Which will result in a fire?
 - a. a plug with a grounded prong
 - b. making connections in a junction box
 - c. allowing bare wires carrying current to touch
11. What should you do if you get scratched by a wire?
 - a. report the accident to your instructor
 - b. ignore the accident since it is not serious
 - c. put a band-aid on the scratch and forget it
12. Draw an arrow pointing to the safety feature on the plug.



13. The reason it is important to handle bare wires carefully is:
 - a. your fingerprints will cause bad connections
 - b. the sharp ends may cut or scratch you
 - c. bare wires are always hot

14. Circle the picture showing a safe use of an electrical appliance.



15. When is it safe to touch the tip of a soldering iron?

- a. it is not safe
- b. when it is unplugged
- c. when it is warming up

16. Before you connect your work to a power source you should:

- a. check your work carefully
- b. have your supervisor check your work
- c. both of the above

17. Follow safety rules and know what you are doing when working with electricity because:

- a. improper wiring can cause fires
- b. electricity can injure or kill unsafe workers
- c. both of the above

18. Before you touch an electrical wire:

- a. put on insulated gloves
- b. make sure it is not a live wire with a tester
- c. read the electrical code

Building Trades - Electrical Construction
Safety Rules in Electrical Wiring

Unit Review

Match the term with it's meaning:

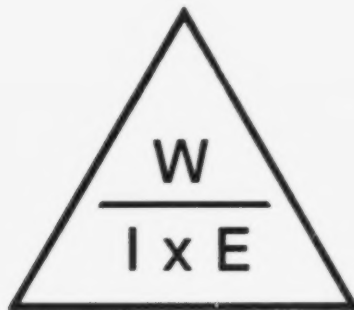
- _____ A. Speed or rate of electric flow
- _____ B. Amount of resistance
- _____ C. Electric pressure
- _____ D. Amount of electricity used - total work done

1. Watts(w)

3. Amperes(I)

2. Volts(E)

4. Ohms(R)



Write the formula for each:

- E. Watts
- F. Volts
- G. Amperes

Building Trades - Electrical Construction
Safety Rules in Electrical Wiring

Performance Checklist

Student _____ has successfully performed the following steps of procedure.

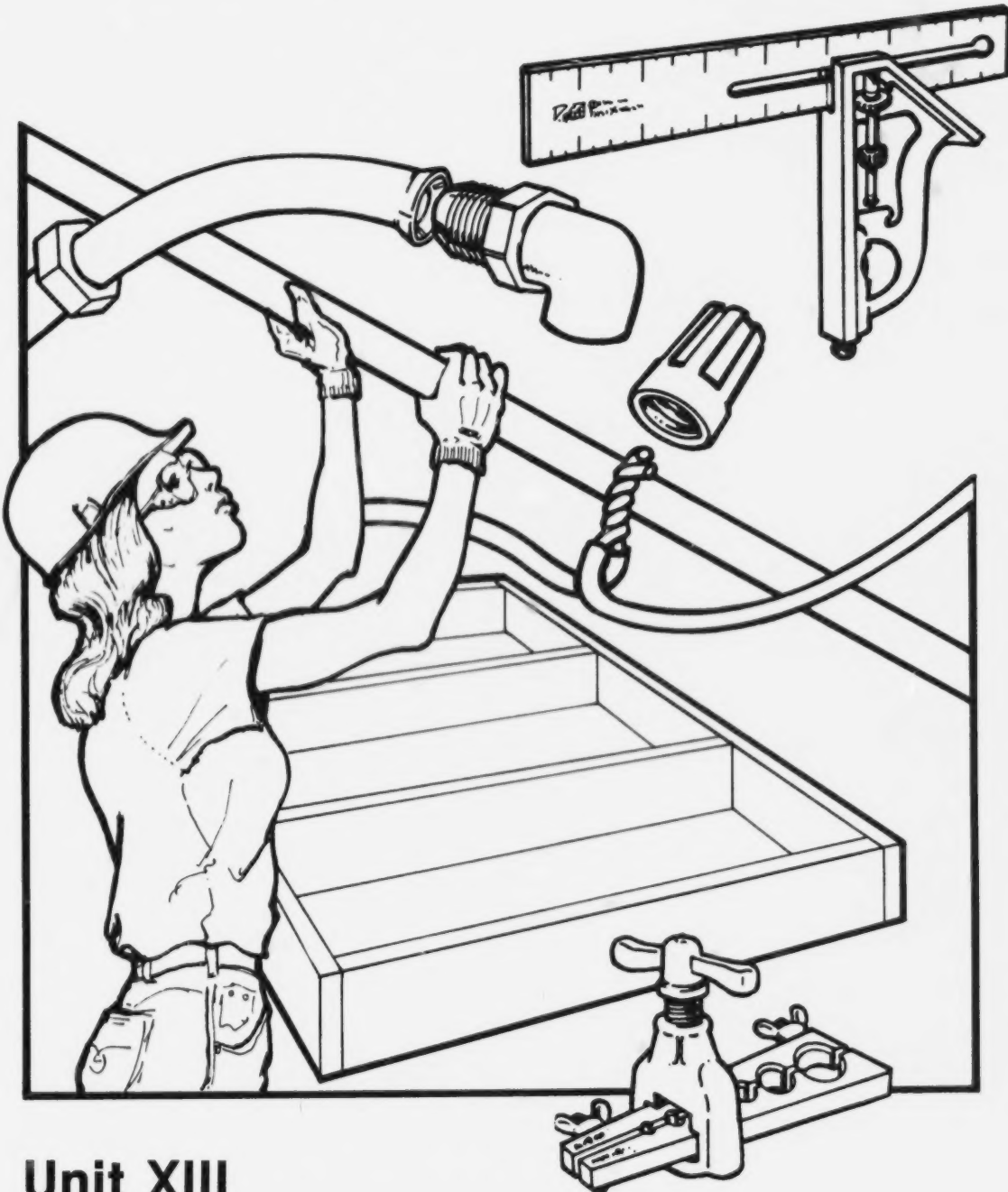
Safety in Electrical Wiring	Yes	No	Comments
1. Identified terms and definitions in electricity			
2. Knew safety rules for electricity			
3. Calculated amperes, volts, and watts correctly			

Should Move On ☐

Repeat This Unit ☐

Student Signature/Date

Instructor Signature/Date



Unit XIII

Roughing-In Electrical Circuits

Building Trades - Electrical Construction

Roughing-In Electrical Circuits

Roughing-In Electrical Circuits

After studying this unit, you will be able to:

1. Trace the path of current flow in a branch circuit.
2. Install a junction box.

Check the Statement that Fits You Best

☐

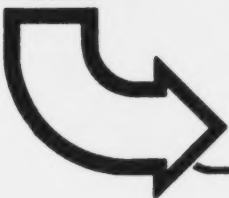
I can do these tasks and want to go through the Performance Checklist.



SEE YOUR INSTRUCTOR

☐

I want to study the information in this unit before I do the Performance Checklist.



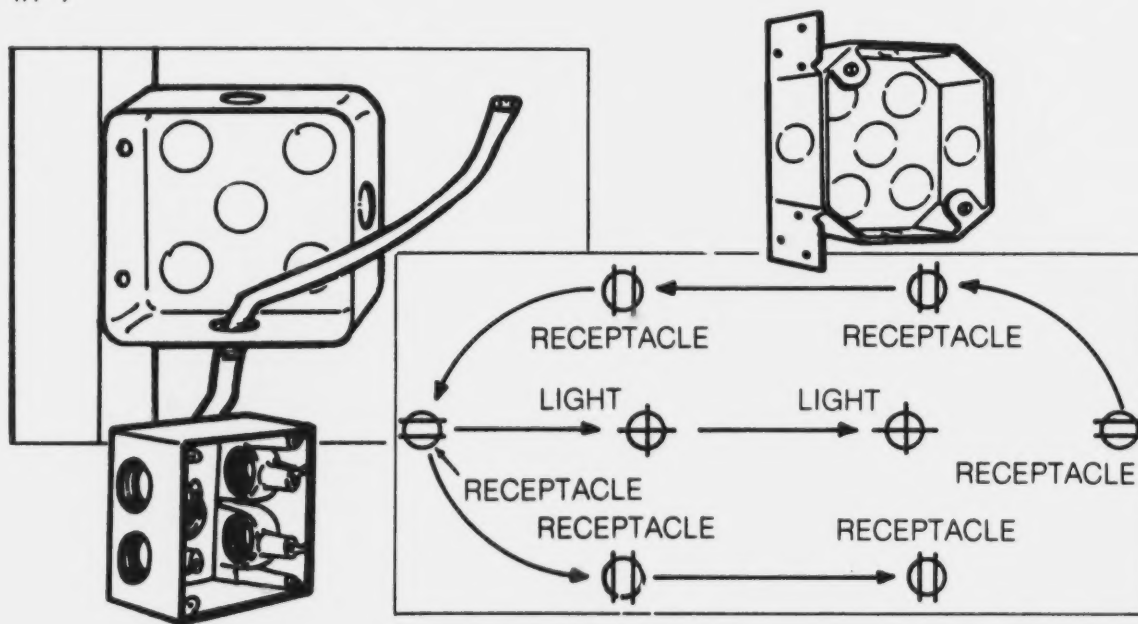
TURN PAGE AND BEGIN

Building Trades - Electrical Construction

Roughing-In Electrical Circuits

Introduction

It is important to know how current flows in a branch circuit in order to install the wiring safely. The wiring is put into new house construction after the framing and before the drywall is hung. This procedure is called "rough-in".



This unit will show you how to trace the path of current in a branch circuit. It will show you how to install cable and junction boxes in open house framing. You will also see tools and materials needed to do this job.

Path of Current Flow

For electricity to do work, it must complete a circle (circuit). Electricity flows along wire from the source through a light bulb or appliance. Then it flows back along a different wire to the source.

In a standard household circuit the black hot wire carries electricity to the light or appliance. The current returns on the white neutral wire to a ground wire at the service entrance.

Too much electricity used on a circuit causes the circuit to be overloaded. Then a fuse blows or the circuit breaker trips.

NOTE: Never use a larger fuse than the circuit wire can handle. A 30-amp. fuse in a 15-amp. circuit can cause the wire to get hot from the extra electricity. The insulation can melt which will cause a fire.

Branch circuits run through the house from the fuse box or breaker panel. By having individual circuits for different parts of the house there is less power loss. Only the part of the house on that circuit loses power when something goes wrong.

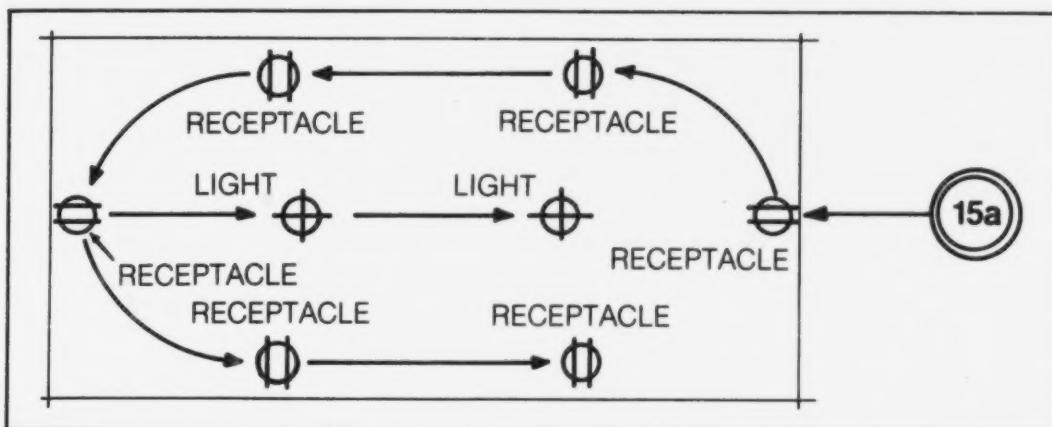
All circuits must be grounded. That means directing live current into the ground which has no voltage. Electricity always follows the path of least resistance. If you touch something that is electrified but properly grounded, the current will flow through the copper grounding wire rather than through you.

In NM cable the bare copper wire is the grounding wire. It should always be connected to a metal switch box to ground the box.

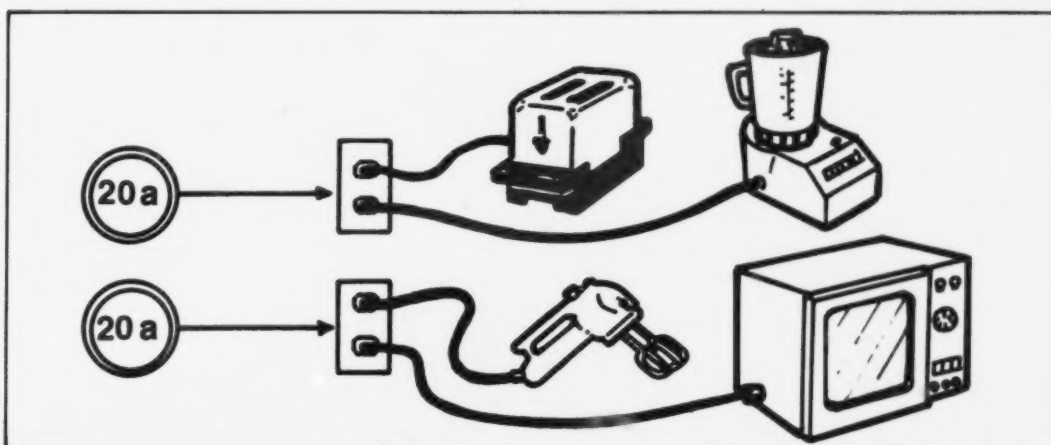
A cold water pipe is often used as the ground to carry the returning flow and loose electricity into the earth.

A home has three basic types of branch circuits.

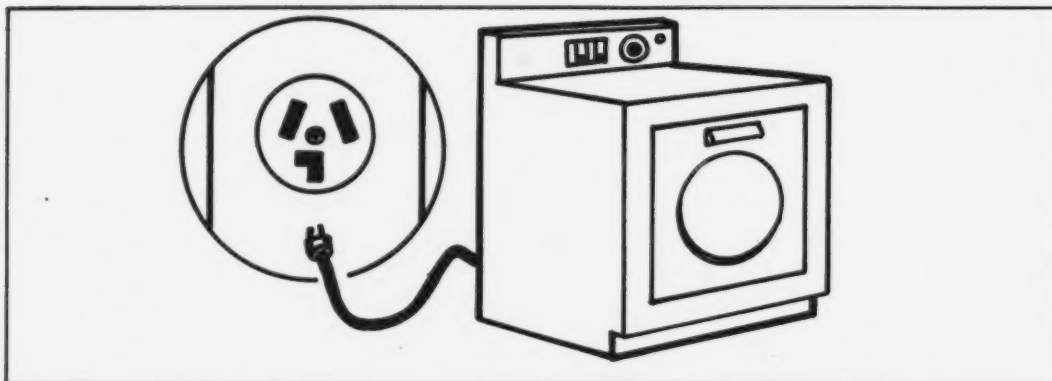
1. Lighting or general purpose circuits: Electricians figure one 15-amp. circuit to each 600 square feet of flooring. Others feel that a 20-amp. circuit for each 500 square feet is best.



2. Small appliance circuit: Two-20 amp. circuits should be installed in the kitchen for small appliances.

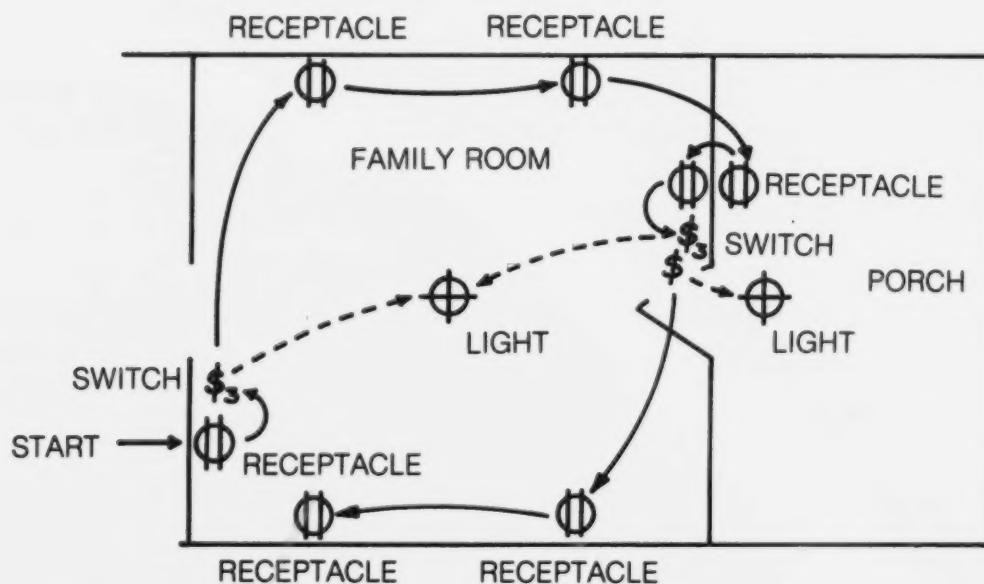


3. Individual appliance circuits: Large appliances like water heaters, dishwashers and electric ranges are normally wired on their own individual circuits. Depending on the demand for current, the circuits may be 120 or 240 volts.



Electricians use wiring plans that show all the circuits. The plans use symbols to show where the lights, receptacles, and switches are located.

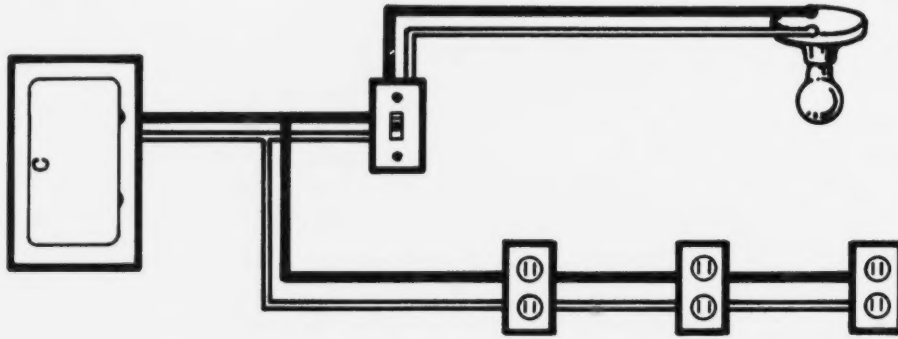
Here is a wiring plan for a new branch circuit in a family room.



Trace the circuit. Follow the arrows. You should find 3 switches, \$ 2 lights, and 7 receptacles.



Trace the path of current in the circuit below. The electricity travels away from the breaker box in the black wire. It travels back on the white wire. The switch breaks the connection for the light. When the switch is on, the current flows to the light and back to the source. When the switch is off, no current flows to the light.



You have seen very simple plans and circuits. Plans for whole buildings are more difficult to read with many more symbols.

Building Trades - Electrical Construction

Roughing-In for Electric Circuits

A. Terms and Definitions

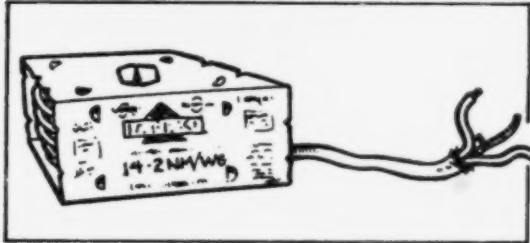
1. Appliance - Electricity-using devices
2. Attach - To fasten
3. Branch Circuit - A circuit that supplies a number of outlets for lights or appliances
4. Extend - To pull the cable end beyond the entrance to the box
5. Flange - A part that projects or sticks out from the box used for mounting the box
6. General Purpose - For a variety of normal uses
7. Individual - Single
8. Install - To put in place for use
9. Normally - Usually, almost always
10. Overload - Too much electricity for the wire
11. Remove - To take out
12. Rough - Not smooth or finished work
13. Run - To push or pull cable through holes in studs from one box to another box
14. Trace - To follow
15. Upright - Standing up, vertical
16. Position - to put in place

Building Trades - Electrical Construction
Wiring a Branch Circuit

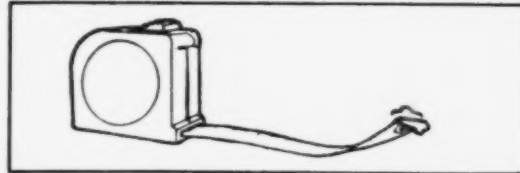
B. Steps for Wiring a Branch Circuit

1. Find the following tools and materials.

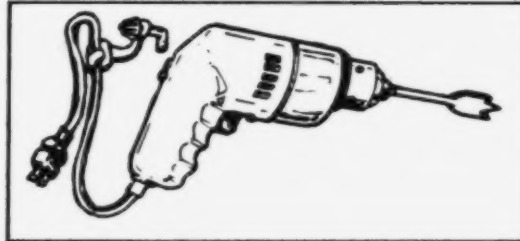
NM Cable with Ground



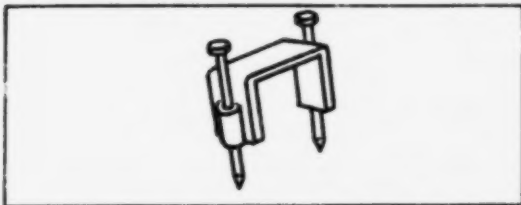
Tape Measure



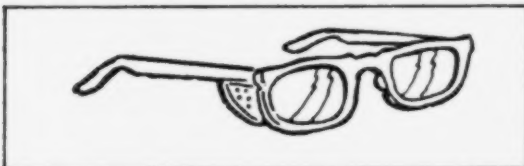
Power Drill w/Spade Bit



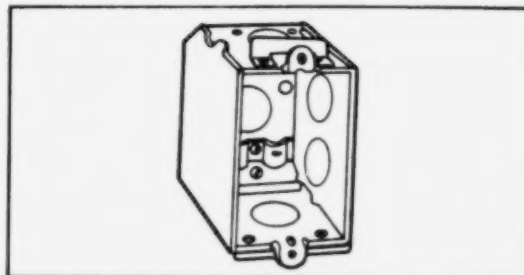
Cable Straps



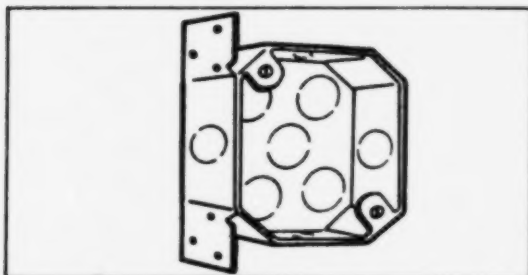
Safety Glasses



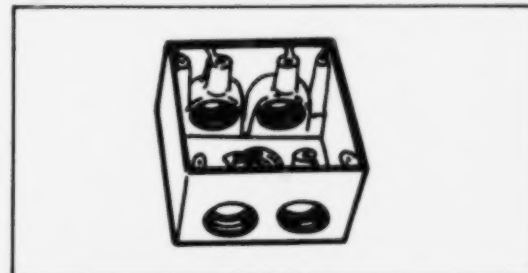
3 Outlet Boxes



Octagonal Box



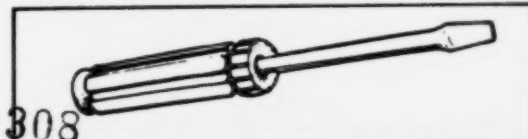
Gang Box



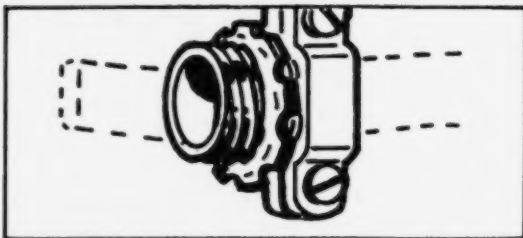
Fasteners



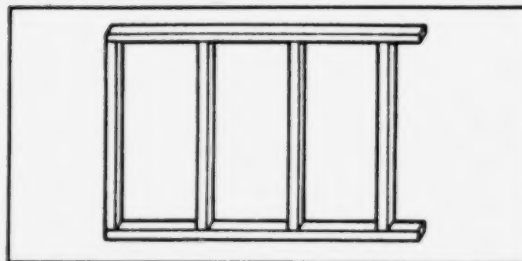
Flathead Screwdriver



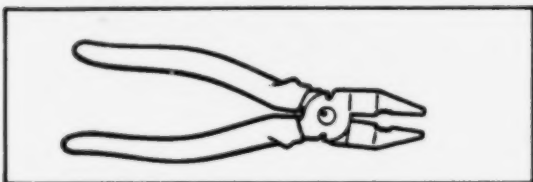
4 Cable Connectors



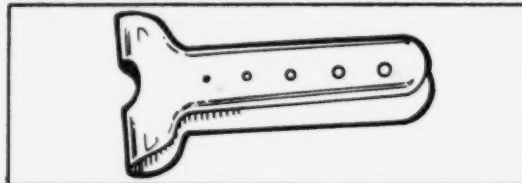
Wood Frame



Side Cutting Pliers



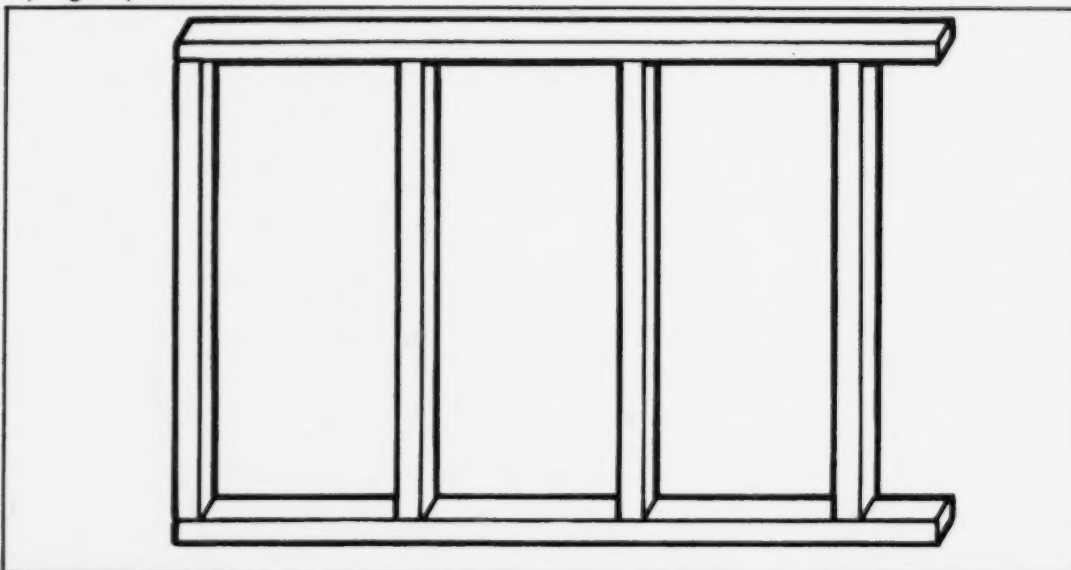
Cable Ripper



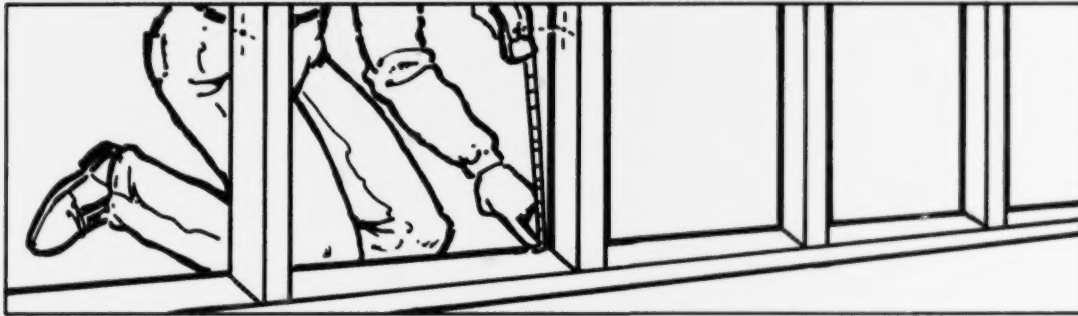
2. Put on safety glasses.



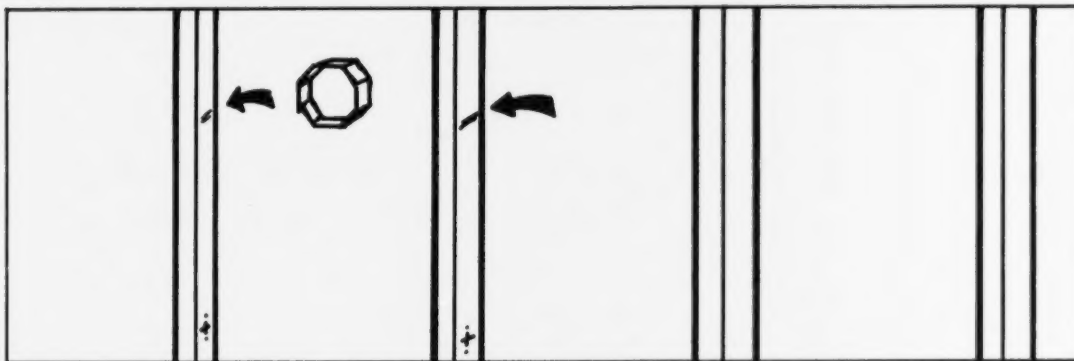
3. Place a wood frame with four and at least 40 '' tall in an upright position.



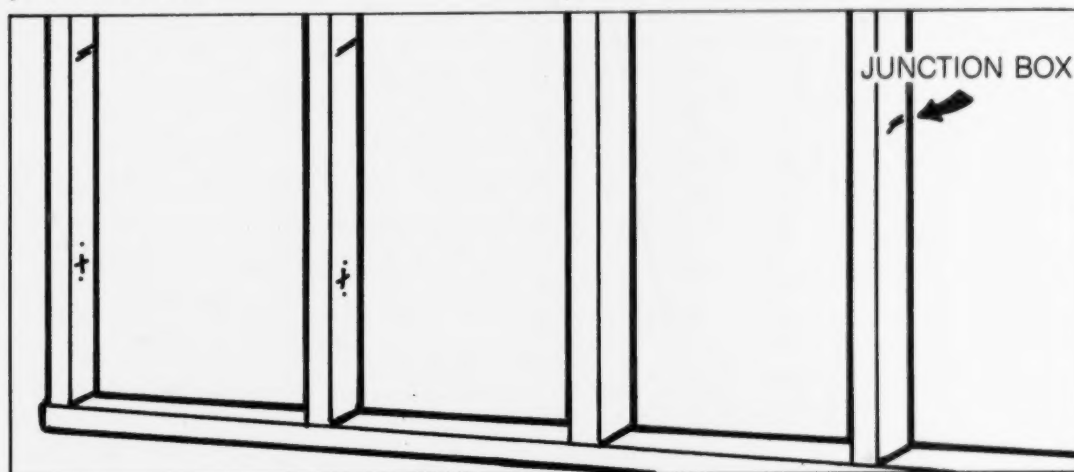
4. The tops of receptacles are normally from 12 to 16 inches above the floor. Decide how high you want the receptacles. Then measure and mark the spots on the first two studs.



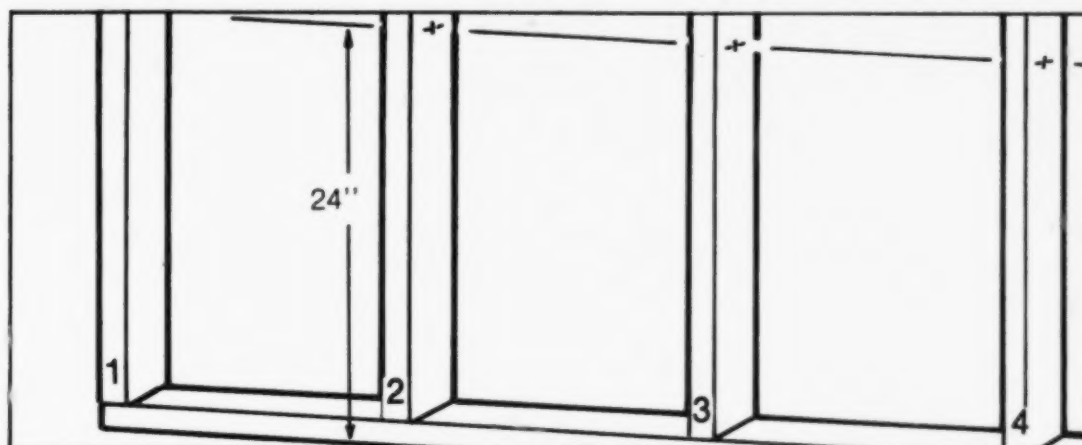
5. The top of the wall switch is normally 44 to 48" from the floor. Decide how high you want the wall switch. Measure and mark the position on the second stud.
6. On the first stud measure and mark where you want the octagon box.



7. On the outside of the fourth stud measure and mark the spot for a junction box.



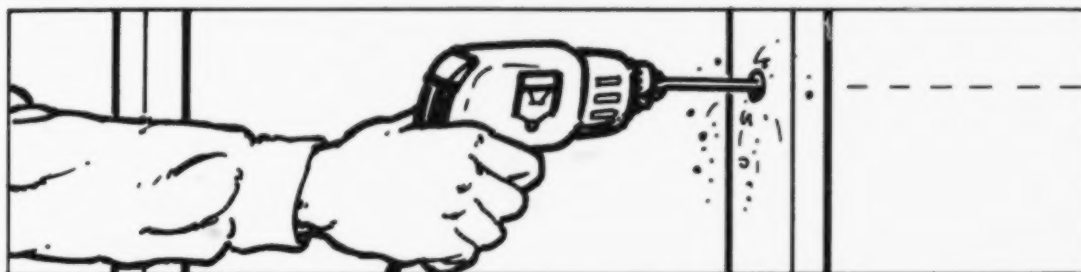
8. Normally holes drilled to run wire are about 24" above the floor. Measure and mark where you want to run the wire to the two lower outlets. Center the marks on the side of the 2x4's in studs 2, 3, and 4.



CAUTION!

If you drill the holes too close to the front, you may drive a nail into the cable and get shocked.

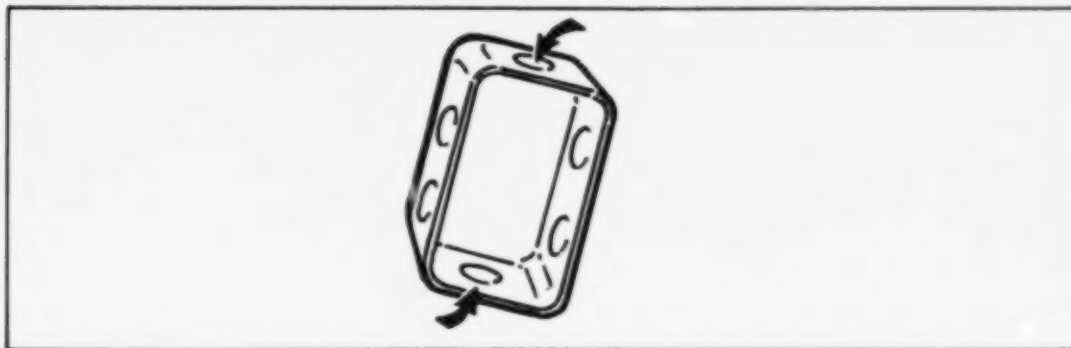
9. Measure and mark where you want to run the wire to the upper boxes. Be sure to center the marks on the sides of the 2x4's.
10. Use a 3/4" or 1" Auger bit and electric drill to drill holes.



NOTE:

When drilling holes for wire you may not be able to fit a drill between the studs. Either drill the holes at a right angle or use a drill with a right angle drilling head.

11. Check the outlet boxes. If no knockouts are missing, remove the top and bottom knockouts.

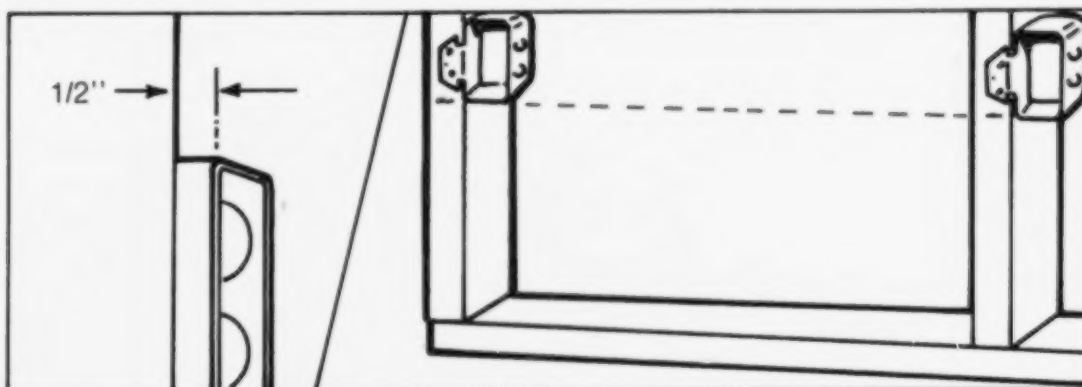


NOTE:

To remove a knockout, rap it sharply with the plier handle. Then twist it back and forth to break the "hinge."



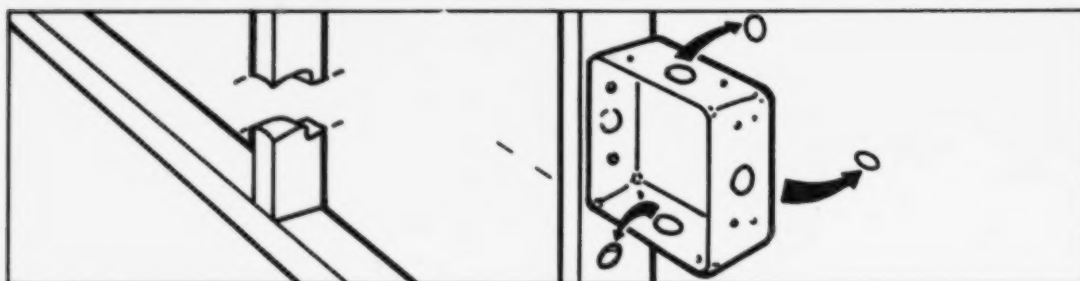
12. Plan to use 1/2" drywall. To allow for the drywall, the outlet switch boxes should stick out 1/2" from the front of the stud. Position the boxes and fasten them in place.



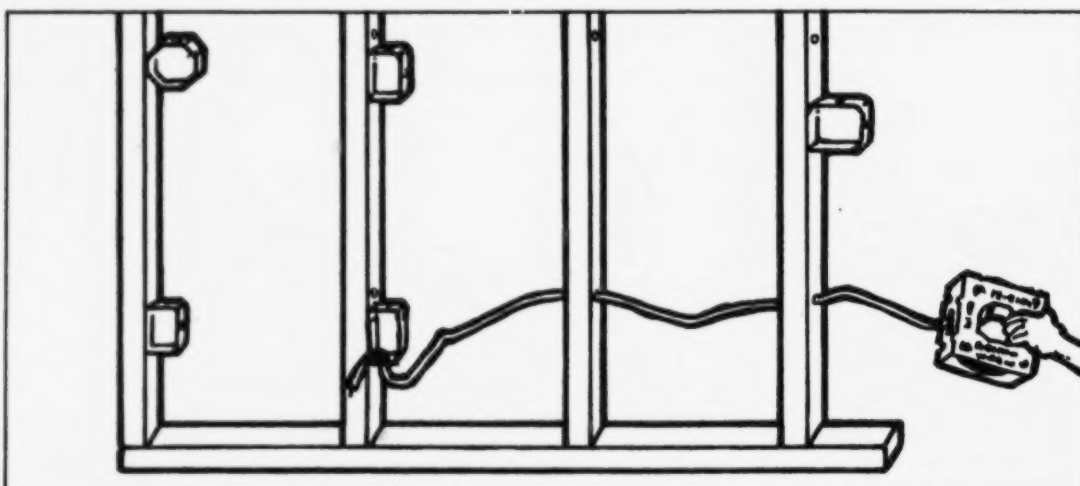
NOTE:

Fasteners may be nails or screws. The method of fastening depends on the kind of box.

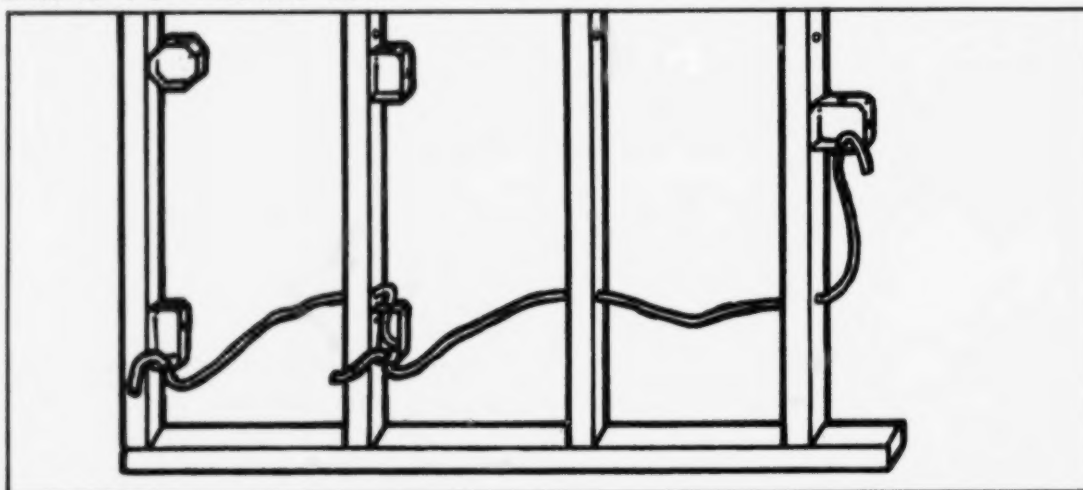
13. Attach the octagon box to the stud at the mark by nailing or fastening screws through the holes in the flange. If no knockouts are missing, remove the top one.



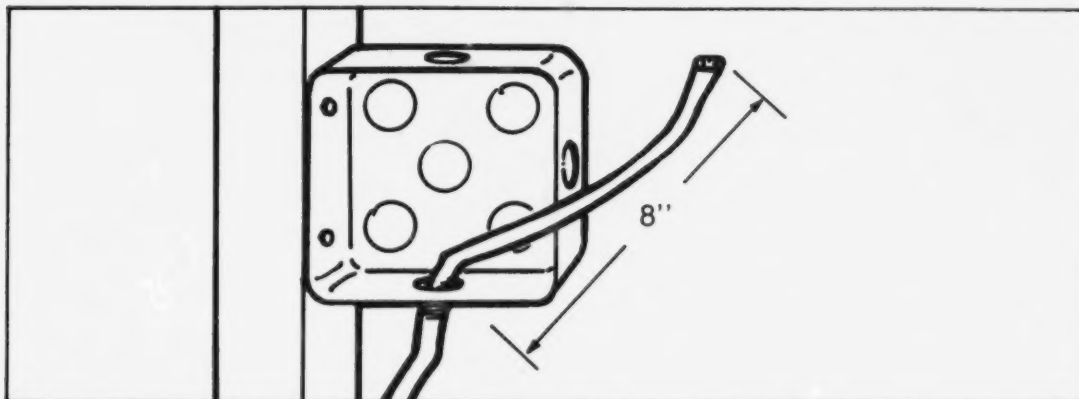
14. Remove knockouts on three sides of the gang box. Fasten it to the fourth stud at the mark.
15. Run the cable through the bottom holes to box on the 2nd stud. Extend it 8" into the box.



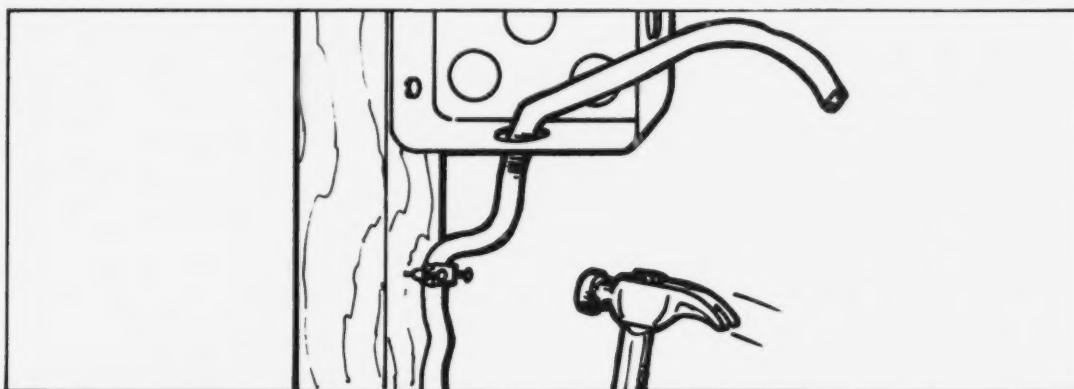
16. Run the cable through the bottom holes to box on the second stud. Extend it 8" into the box.



17. Run cable from one outlet box to the other bottom one. Extend cable 8" into each box and cut it.

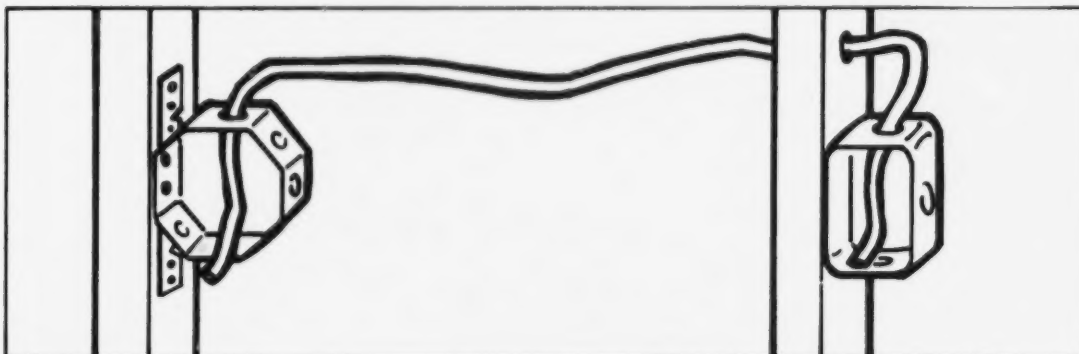


18. Fasten cable to the side of the frame.



19. Run cable from junction box to top outlet box.

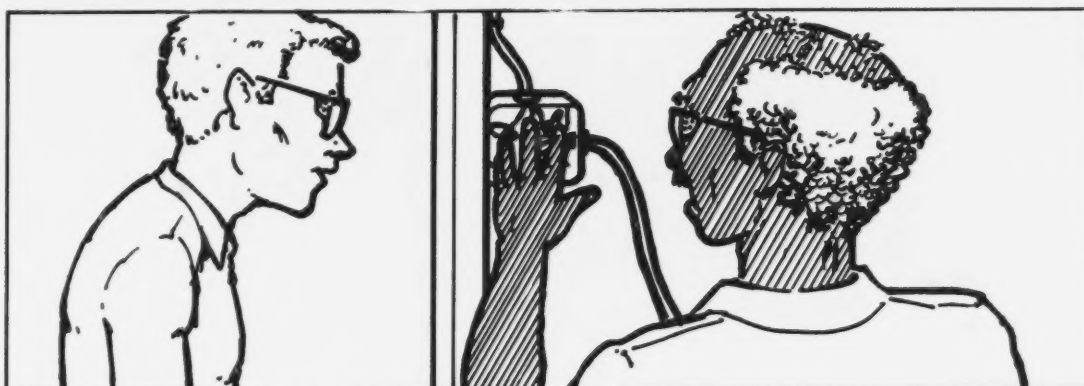
20. Extend it 8" into the boxes on each end.



21. Run the cable from the outlet box to the octagon box.
22. Extend it 8" into the boxes on each end.



23. Have your instructor check your wiring work.



24. Clean your work area. Put tools and safety equipment away.

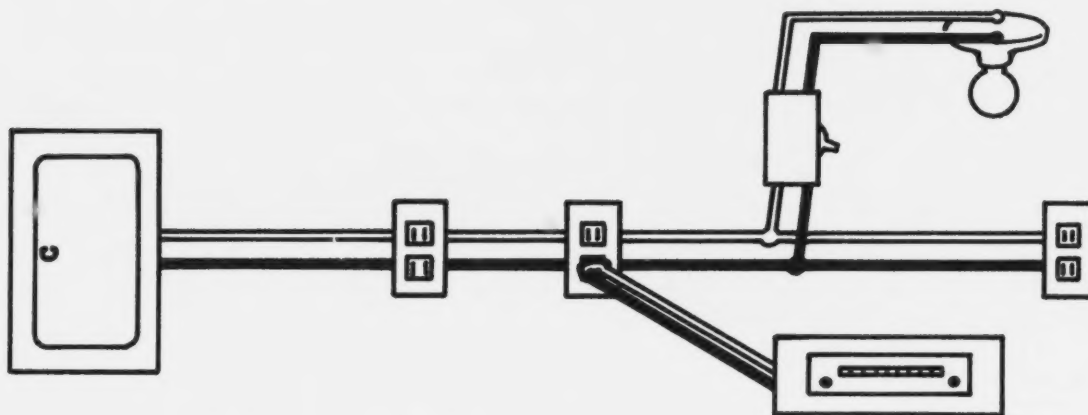
SEE YOUR INSTRUCTOR

Building Trades - Electrical Construction
Roughing-In Electrical Circuits

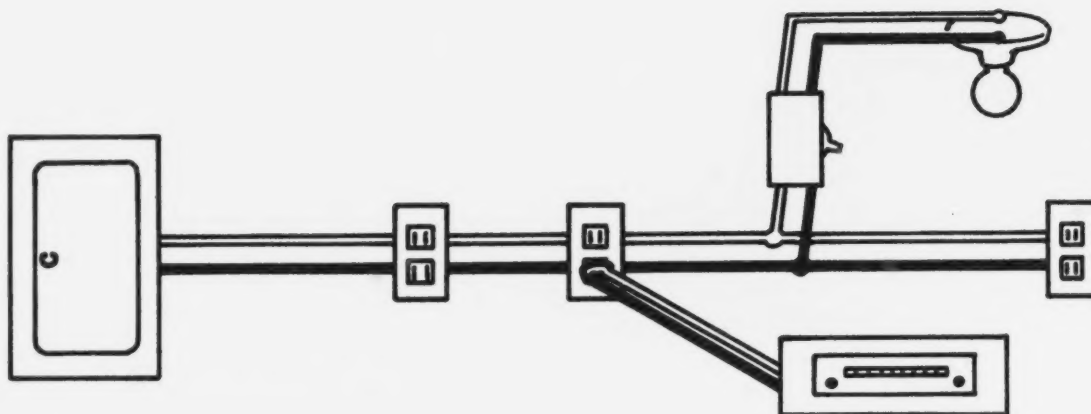
Skill Sheet One
Roughing-In Electrical Circuits

Draw arrows to show the path of the current in the circuits shown below.

A. When the switch is on.



B. When the radio is turned on.



Building Trades - Electrical Construction
Roughing-In Electrical Circuits

Unit Review

Use the following words to complete the sentences:

circuit ground
black overload
white

1. The _____ (hot) wire carries electricity to the light.
2. The _____ wire directs live current into the ground.
3. The _____ (neutral) wire returns the current to a ground wire at the service entrance.
4. For electricity to do work, it must complete a _____.
5. Too much electricity for the wire is an _____.

Circle the letter of the best answer.

6. One 15 amp. circuit is enough for 600 square feet of flooring if it is used for:
 - a. lighting
 - b. small appliances
 - c. large appliances
7. The minimum number of 20 amp. small appliance circuits in a kitchen should be:
 - a. one
 - b. two
 - c. three
8. The symbol that shows a switch is:
 - a. 
 - b. 
 - c. 
9. The symbol that shows a receptacle is:
 - a. 
 - b. 
 - c. 

10. The symbol that shows a light is:
- 
 - 
 - 
11. Rough-in wiring is done in a(n)
- finished basement
 - open framework for an addition
 - outdoor underground wiring
12. Draw the wires to connect this circuit. Draw arrows to show the current flow.



13. "Run a wire" means to:
- to push or pull cable
 - to jog
 - to remove
14. What should happen when a circuit is overloaded?
- the lights flash
 - an alarm rings
 - the fuse blows
15. The source for branch circuits is the:
- breaker panel
 - generator
 - utility pole
16. What size fuse or breaker should you use for a 15 amp. circuit?
- 15 amp.
 - 20 amp.
 - 30 amp.
17. What material offers the least resistance to electricity?
- skin
 - copper
 - porcelain
18. In NM cable the grounding wire is:
- black
 - white
 - bare copper

19. A branch circuit supplies electricity to:
 - a. the whole house
 - b. a part of the house
 - c. the breaker box
20. When wiring a house, you will follow a:
 - a. wiring plan
 - b. map
 - c. written set of directions

Building Trades - Electrical Construction

Roughing-in Electrical Circuits

Performance Checklist

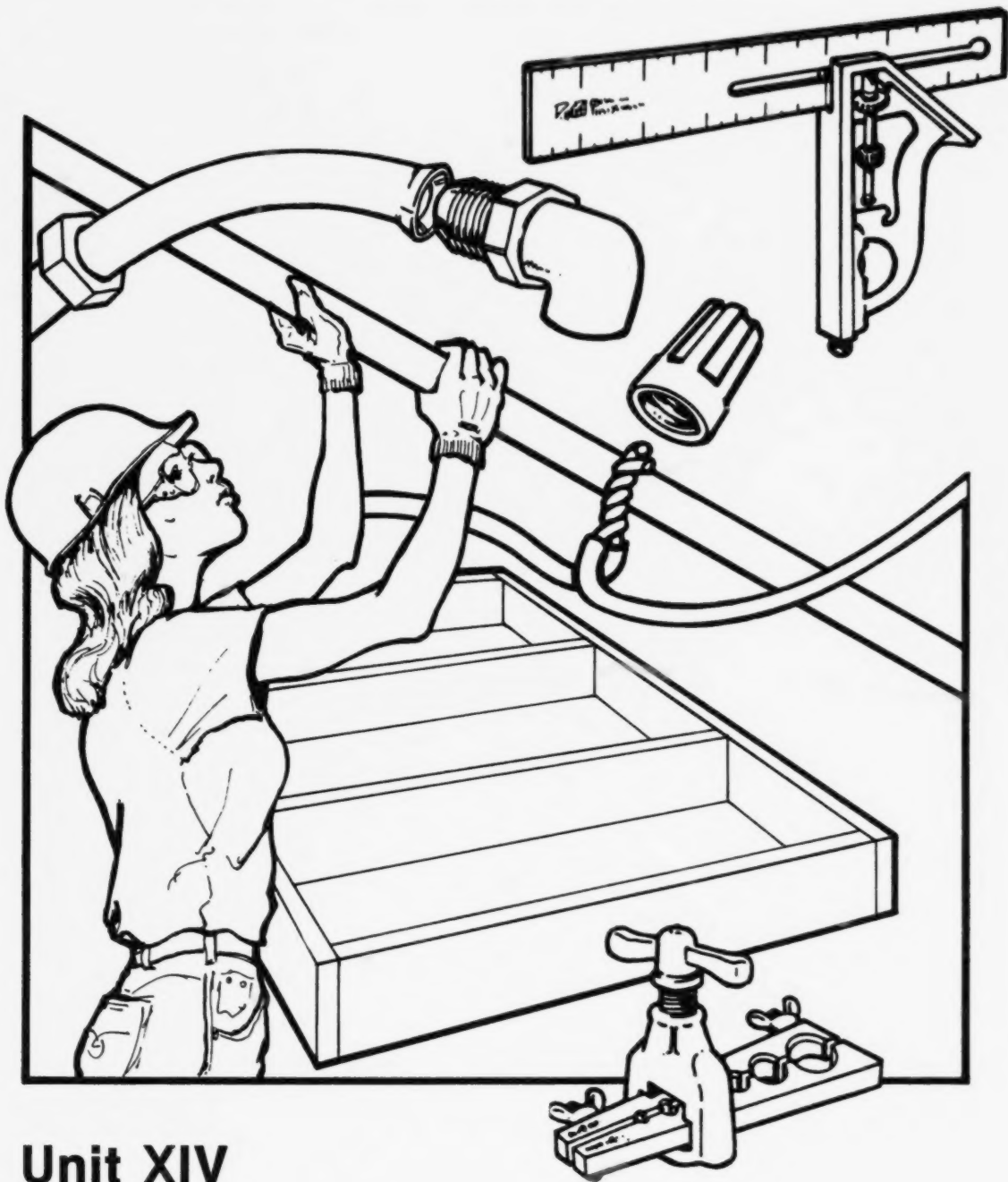
Student _____ has successfully performed the following steps of procedure.

Electrical Currents	Yes	No	Comments
1. Understood concept of current flow			
2. Recognized new terms and equipment for roughing-in electrical circuits			
Wiring a Branch Circuit			
1. Assembled tools and equipment			
2. Put on safety equipment			
3. Marked locations on studs for receptacles and boxes			
4. Measured, marked, and drilled holes for wiring			
5. Correctly fastened receptacle boxes to studs			
6. Ran cable to boxes and fastened cable to wall frame.			
7. Left proper surplus amount of wiring for electrical connections			
8. Cleaned area; put away equipment and tools			

Should Move On ☐
Repeat This Unit ☐

Student Signature/Date

Instructor Signature/Date



Unit XIV

Making Electrical Connections

Building Trades - Electrical Construction

Making Electrical Connections

Making Electrical Connections

After studying this unit, you will be able to:

1. Identify tools and materials used to make electrical connections.
2. Make a pigtail splice with solderless connectors.
3. Solder and tape a pigtail splice.

Check the Statement that Fits You Best

☐

I can do these tasks and want to go through the Performance Checklist.



SEE YOUR INSTRUCTOR

☐

I want to study the information in this unit before I do the Performance Checklist.



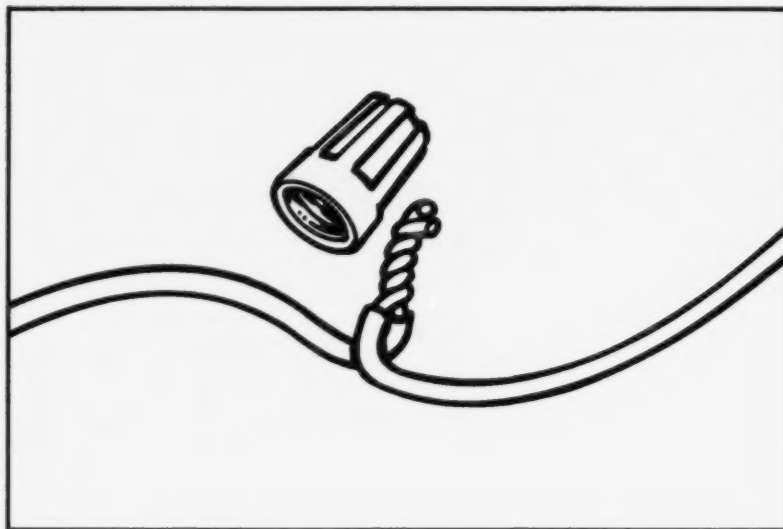
TURN PAGE AND BEGIN

Building Trades - Electrical Construction

Making Electrical Connections

Introduction

An electrical connection made by twisting two wires together is called a splice. When doing electrical construction work, you will have to know how to splice electrical wires. The main reasons you would make splices are to join shorter wires or to tap into a main electrical line. In house wiring, these splices are always made in an electrical box as a safety precaution.



In this unit, you will learn how to splice wires with a wire nut (solderless connection) and with solder and tape. Be sure to remember the safety rules as you work with splicing wire.

TURN TO NEXT PAGE

Building Trades - Electrical Construction

Making Electrical Connections

A. Terms and Definitions

1. Wire Nut - A screw-on solderless connector
2. Solderless Wire Connector - Joins wires together, this can be a wire nut, split-bolt, or crimp-type
3. Splice - Joining together of two or more wires to make a connection
4. Work Station - Area for doing soldering work
5. Vise - Clamp mounted on work station to hold work in place

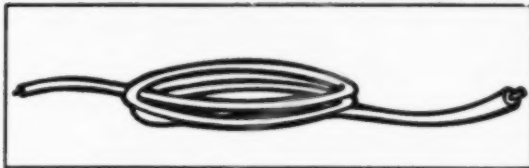
Building Trades - Electrical Construction

Making Electrical Connections

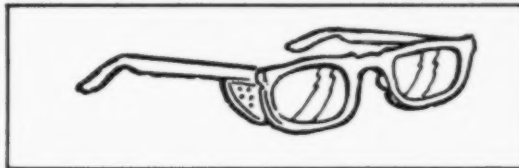
B. Steps for Making a Pigtail Splice with Solderless Connectors

1. Find the following tools and materials.

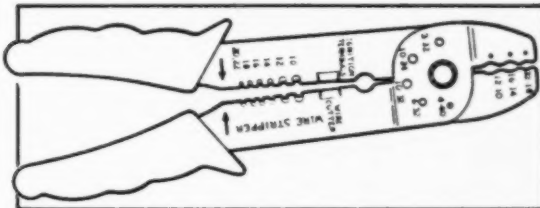
Electrical Wire



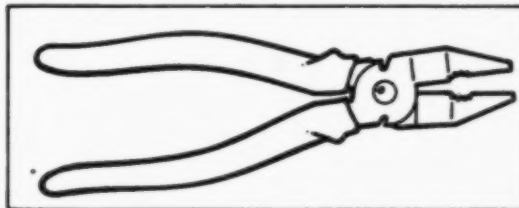
Safety Glasses



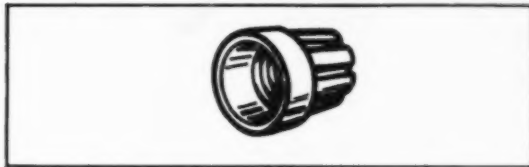
Wire Stripper/Cutter



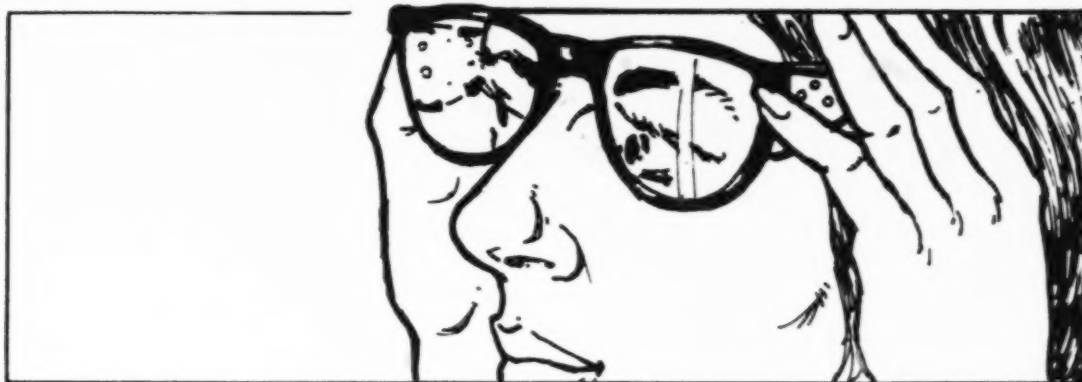
Side Cutting Pliers



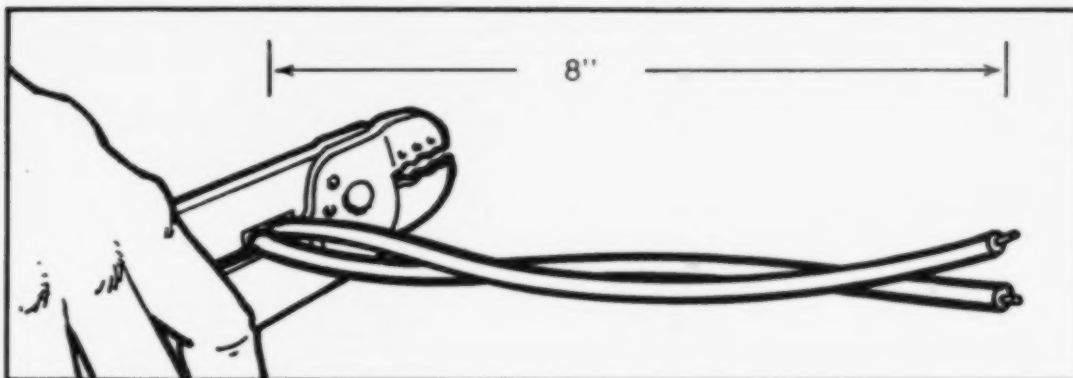
Wire Nut



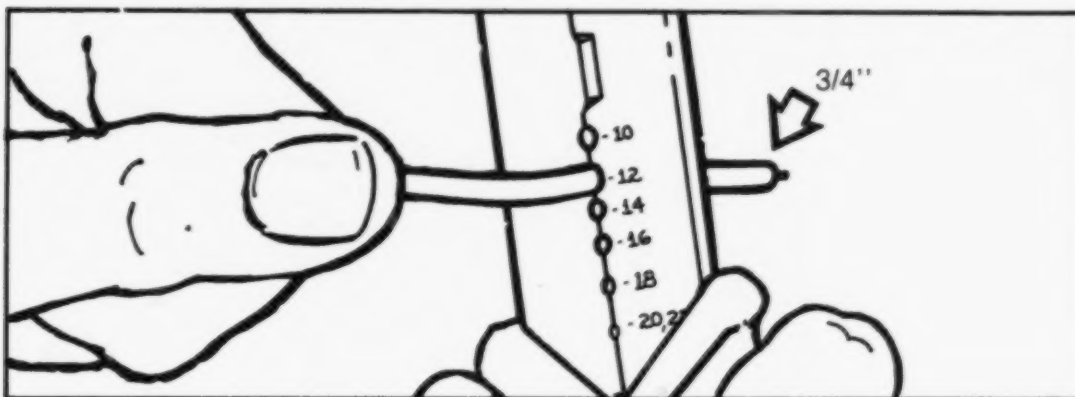
2. Put on safety glasses.



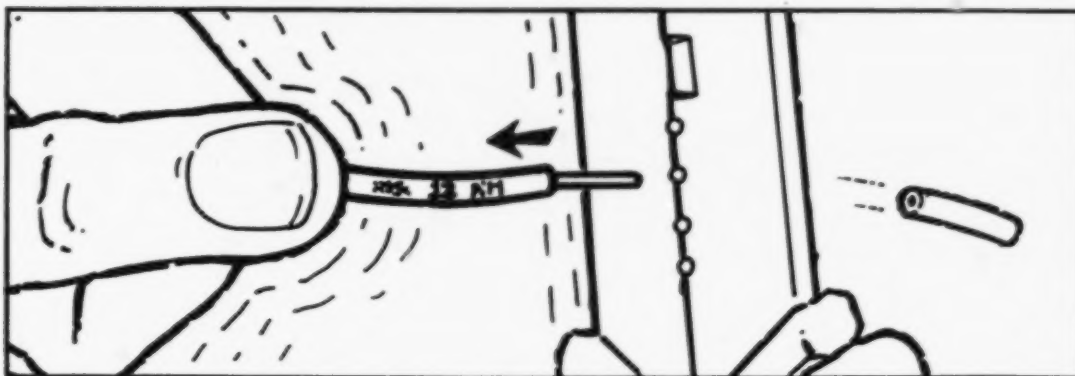
3. Cut Number 12 or Number 14 electrical wire into two eight-inch pieces.



4. Select the correct opening in the wire stripper and insert the wire about $\frac{3}{4}$ " into that opening.



5. Close strippers and pull insulation from the wire.



CAUTION!

Be sure the tool cuts the insulation but not the wire. If the wire is nicked, it will be weakened.

6. Strip one end of the other wire in the same way.
7. Cross the bare wires and hold them with thumb and fingers.

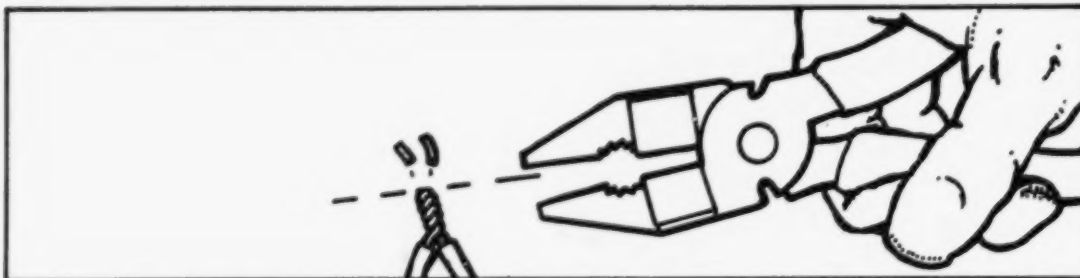


8. With the side cutting pliers, grasp wires near the end and twist them two or three turns.

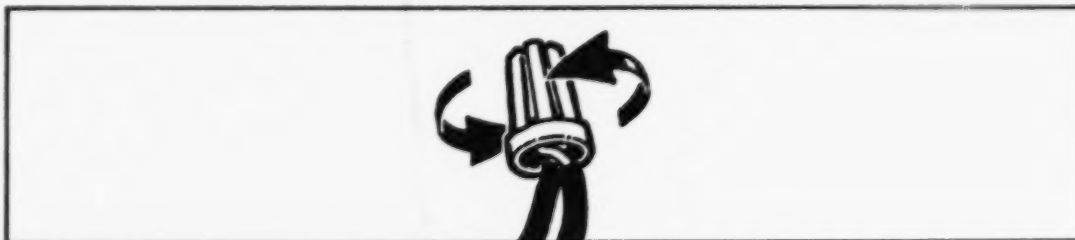


CAUTION! Always use tools with insulated handles.

9. Cut off excess wire with pliers.



10. Choose wire nut to match wire size.
11. Slip the wire nut onto the twisted wires and turn in a clockwise direction until the wire nut is tight.



CAUTION! The wire nut must cover all of the bare wire.

SEE YOUR INSTRUCTOR

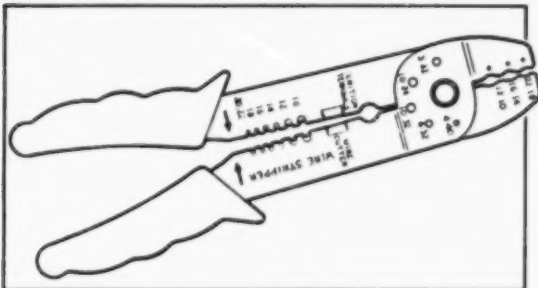
Building Trades - Electrical Construction

Making Electrical Connections

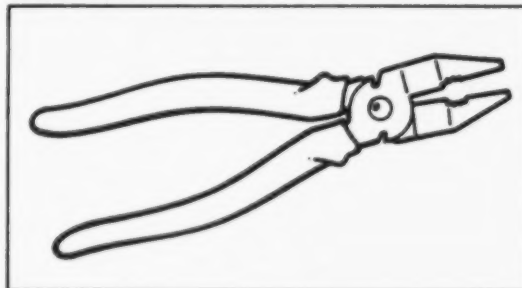
C. Steps for Soldering and Taping a Pigtail Splice

1. Assemble the following tools and materials.

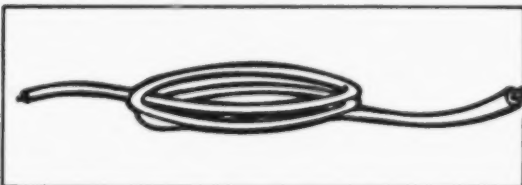
Wire Stripper



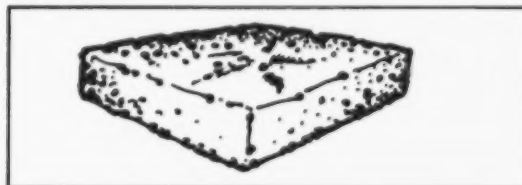
Side Cutting Pliers



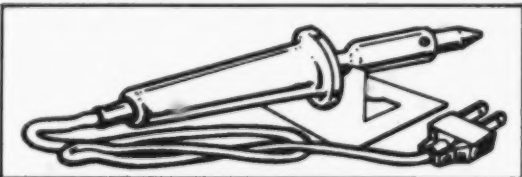
Electrical Wire



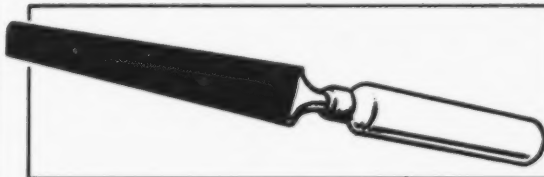
Sponge



Soldering Iron



File



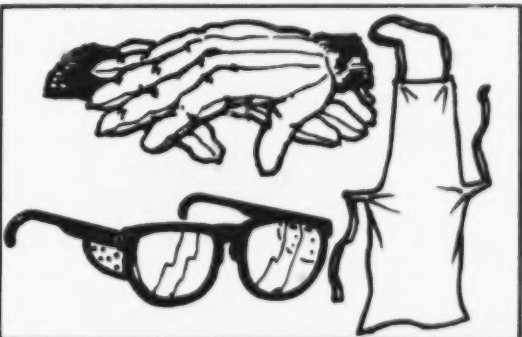
Plastic Electrical Tape



Rosin Flux Solder



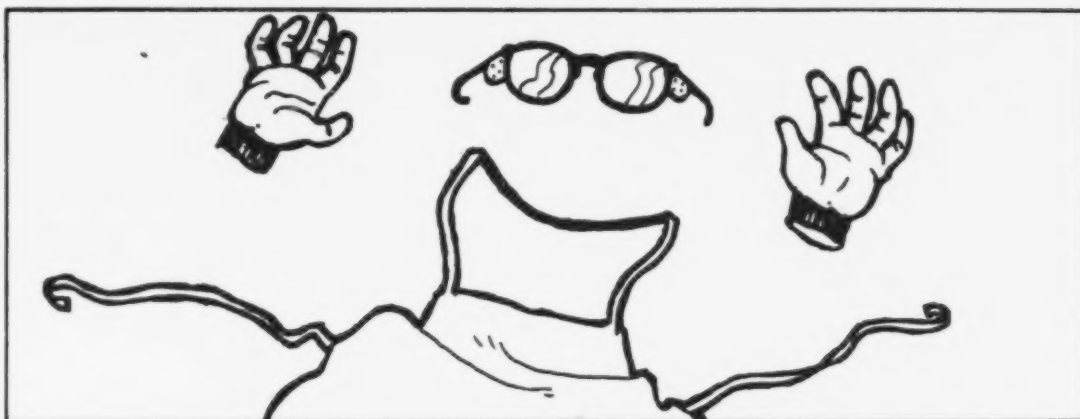
Safety Equipment



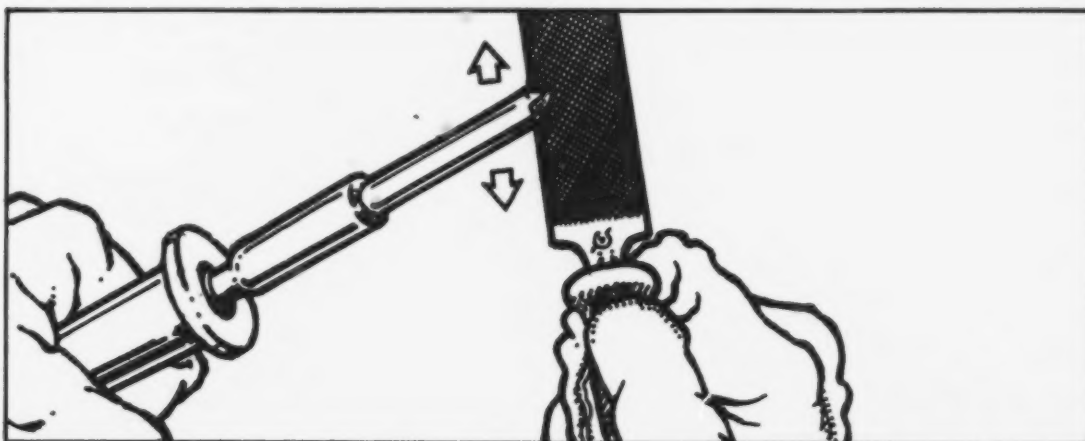
Steel Wool



2. Put on safety glasses, gloves, and apron.



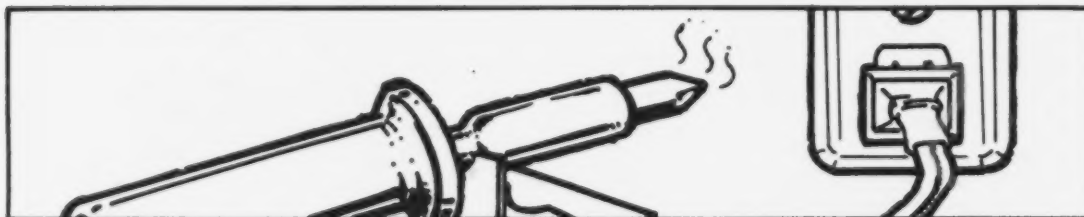
3. File the soldering iron tip until it is clean and shiny.



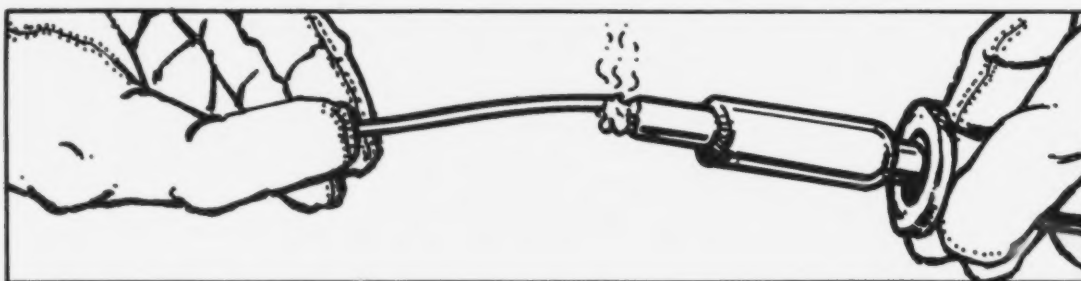
CAUTION!

Never file tip while soldering iron is plugged into an outlet.

4. Plug in the soldering iron and let it heat up for three to five minutes.



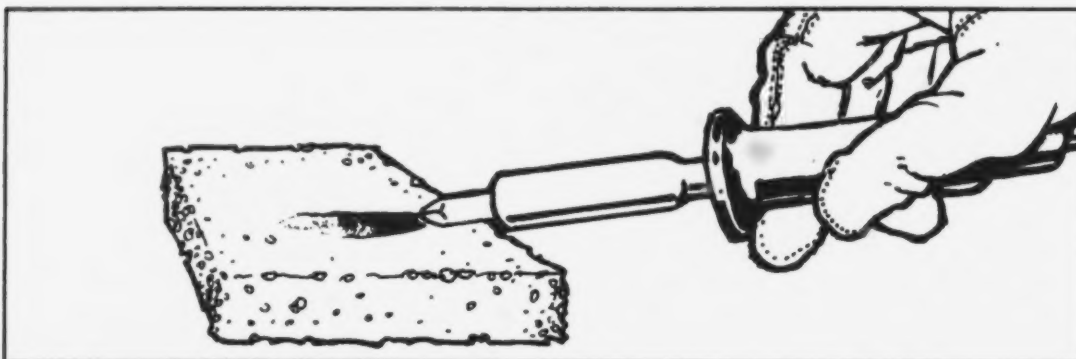
5. Touch the rosin flux solder to the tip of the soldering iron.



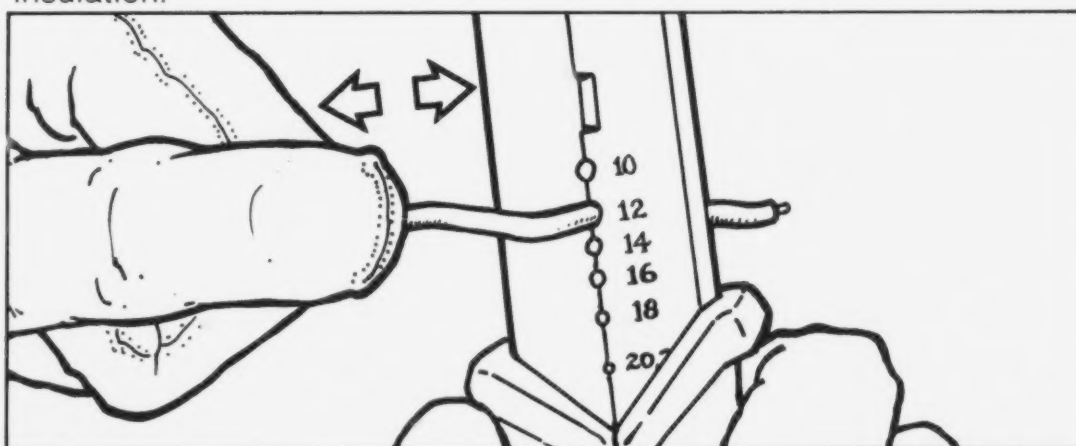
NOTE

If the tip is hot, the solder will melt and flow around the tip. Solder will smoke as the flux is "cooked" out.

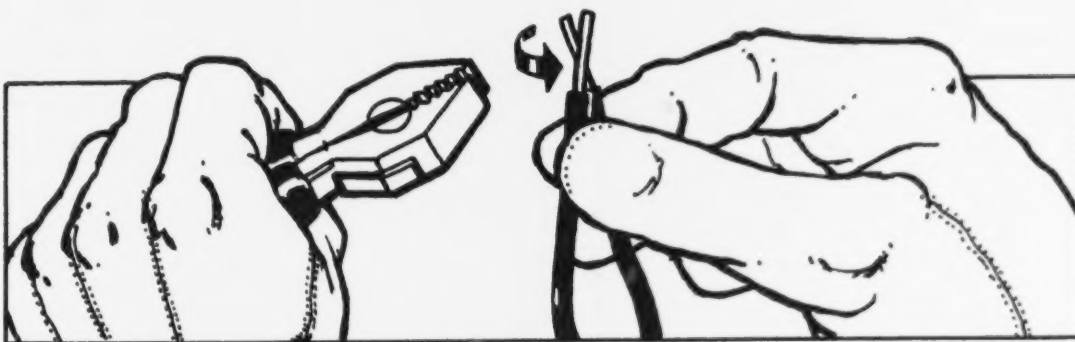
6. Wipe the soldering iron tip with a damp sponge when the smoke stops.



7. Strip the wires that you are going to splice. Remove 3/4" of insulation.



8. Twist the bare wires together with the pliers.



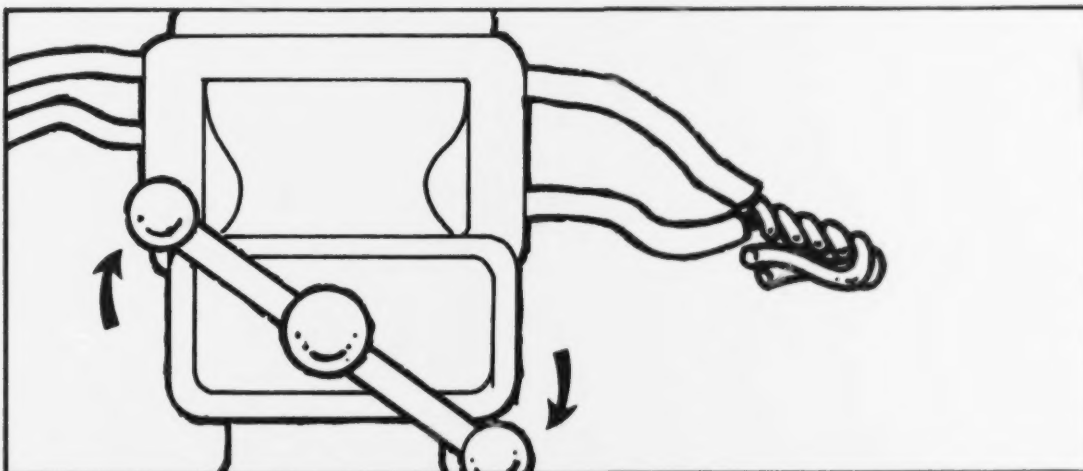
CAUTION!

Do not touch the bare wires with your fingers.

9. Bend the excess wire back with the pliers.



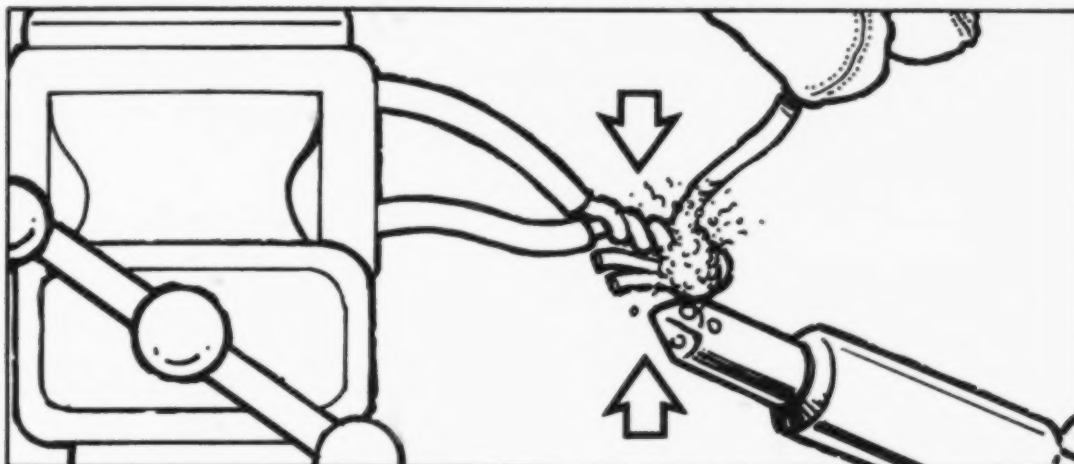
10. Fasten the splice in the vise on the work station.



NOTE

When soldering a splice, the excess wires should be bent back over the twist and not cut off.

11. Heat the pigtail splice by placing the soldering iron against the bottom side of the splice.
12. While heating the splice, apply the solder to the top of the splice.

**NOTE**

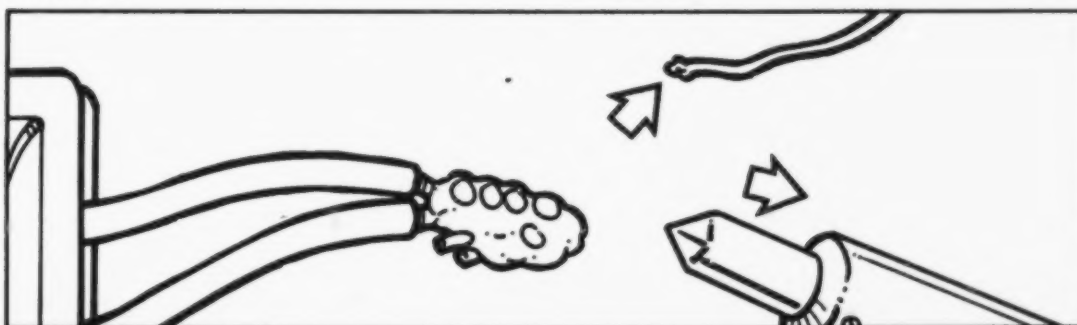
Always apply heat below the splice
and
always apply solder above the splice.

13. Melt solder smoothly over the entire splice.

**CAUTION!**

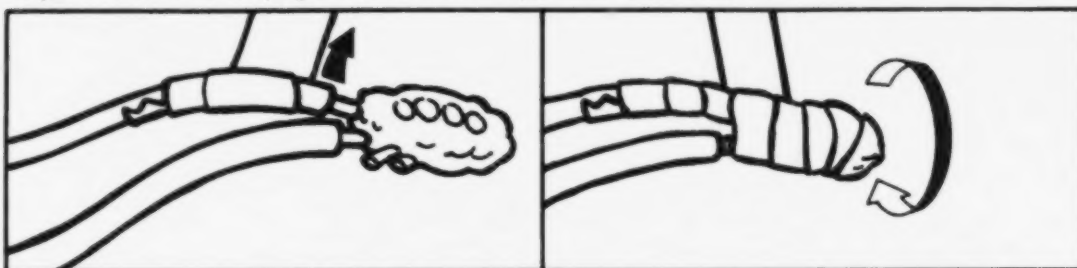
Hot solder may drip from the splice.

14. Remove solder and soldering iron. Unplug soldering iron when finished.

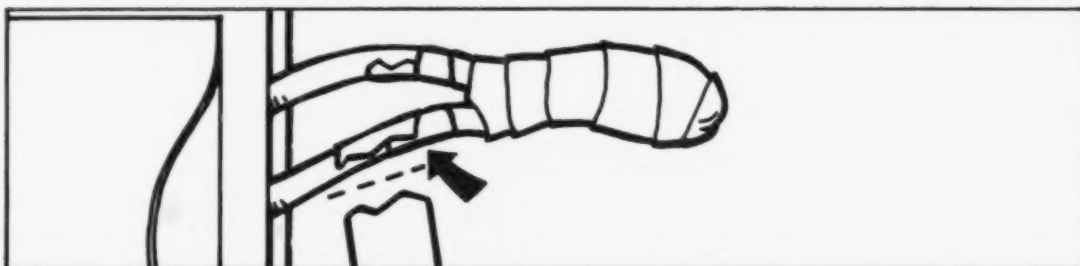
**NOTE**

Do not move soldered splice until the silvery colored solder
has cooled and hardened to a dull white.

15. When cooled, begin taping on one wire about one inch from the splice.
16. Tape toward the pigtail; double tape the bare end.



17. Tape back in the direction from which you started and stop about one inch up on the other wire.

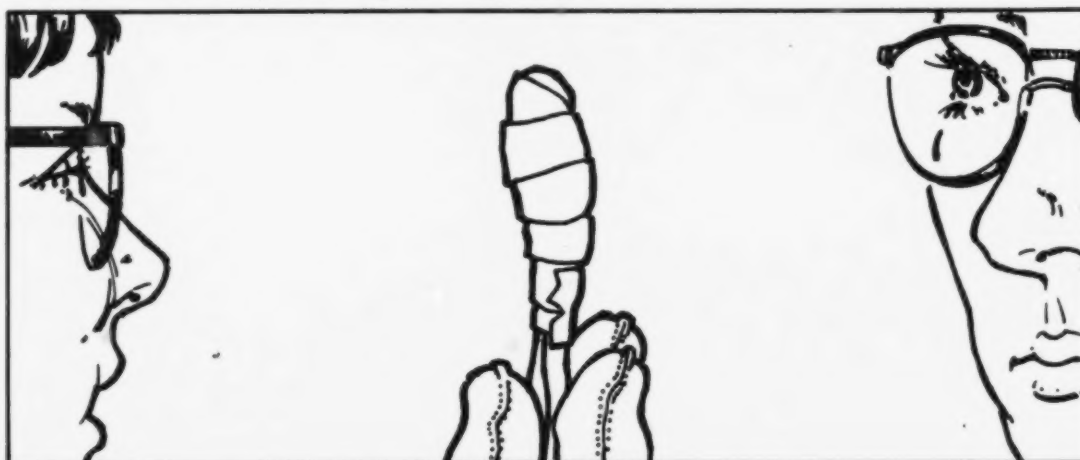


18. Tape the wires together in front of the splice.
19. Cut the tape.



NOTE: The tape acts as insulation and helps prevent the splice from breaking.

20. Show finished splice to your instructor.



21. Clean work station and return safety equipment, tools, and materials to their proper places.

SEE YOUR INSTRUCTOR

Building Trades - Electrical Construction

Making Electrical Connections

Unit Review

Directions: Choose the best answer by circling the letter in front of the word that makes the statement correct.

1. To make a solderless connection use a:
 - a. pigtail splice
 - b. wire nut
 - c. cable connector
2. An electrical connection made by twisting two wires together is a:
 - a. junction box
 - b. cable connector
 - c. pigtail splice
3. Which tools are used to make electrical connections?
 - a. wire stripper/cutter, side cutting pliers, and soldering iron
 - b. screwdriver, cable ripper, and drill
 - c. long nose pliers, hammer, and continuity tester
4. The main reason to make a splice is:
 - a. to save wire
 - b. to join shorter wires
 - c. to make wires stronger
5. Splices should always be contained in:
 - a. open framework
 - b. fixtures
 - c. electrical boxes
6. If the wire stripper nicks the wire, what happens?
 - a. the wire is weakened and may break
 - b. nothing will happen
 - c. the wire won't bend
7. What opening on the wire stripper would you pick for Number 14 wire?
 - a. 10
 - b. 12
 - c. 14
8. What tool do you use to twist wires in a splice?
 - a. wire stripper
 - b. pliers
 - c. vise

9. What direction do you turn a wire nut to twist it on?
 - a. clockwise
 - b. counterclockwise
 - c. a and b
10. What type of solder should you use to solder a splice?
 - a. acid core solder
 - b. solid solder
 - c. rosin flux core solder
11. Heat the pigtail splice by placing the soldering iron against:
 - a. the side of the splice
 - b. the bottom of the splice
 - c. the top of the splice
12. Apply solder to:
 - a. the side of the splice
 - b. the bottom of the splice
 - c. the top of the splice
13. The main danger when soldering is:
 - a. the hot soldering iron burning you
 - b. the splice catching on fire
 - c. the solder melting the wires
14. Tape wrapped around the soldered splice:
 - a. acts as insulation
 - b. helps prevent the splice from breaking
 - c. both a and b
15. When soldering a splice, excess wire should be:
 - a. cut off
 - b. bent back
 - c. twisted together

Building Trades - Electrical Construction
Making Electrical Connections

Performance Checklist

Student _____ has successfully performed the following steps of procedure.

Making a Pigtail Splice with Solderless Connectors	Yes	No	Comments
1. Gathered equipment and supplies			
2. Put on safety glasses			
3. Cut two 8 inch pieces of No. 12 or No. 14 wire			
4. Stripped 3/4 inch insulation from one end of each wire			
5. Twisted bare wires together with pliers			
6. Cut off excess wire			
7. Selected correct wire nut			
8. Twisted wire nut clockwise onto wires			
Soldering and Taping a Pigtail Splice	Yes	No	Comments
1. Assembled necessary tools and materials			
2. Put on safety glasses			
3. Filed tip of soldering iron			
4. Heated soldering iron for three to five minutes			
5. Touched rosin flux solder to tip of soldering iron			
6. Wiped tip of iron to damp sponge			
7. Striped 3/4 inch of insulation from the wires			
8. Twisted bare wires together with pliers			
9. Bent back excess wire			
10. Fastened splice into vice			
11. Heated splice by holding iron against the bottom of the splice			
12. Applied solder to the top of the splice			
13. Melted solder over the entire splice			
14. Removed solder and iron			

Soldering and Taping a Pigtail Splice	Yes	No	Comments
15. Unplugged iron			
16. Allowed the splice to cool to a dull white color			
17. Taped each wire			
18. Taped the wires together			
19. Cleaned work station and put away tools and supplies			

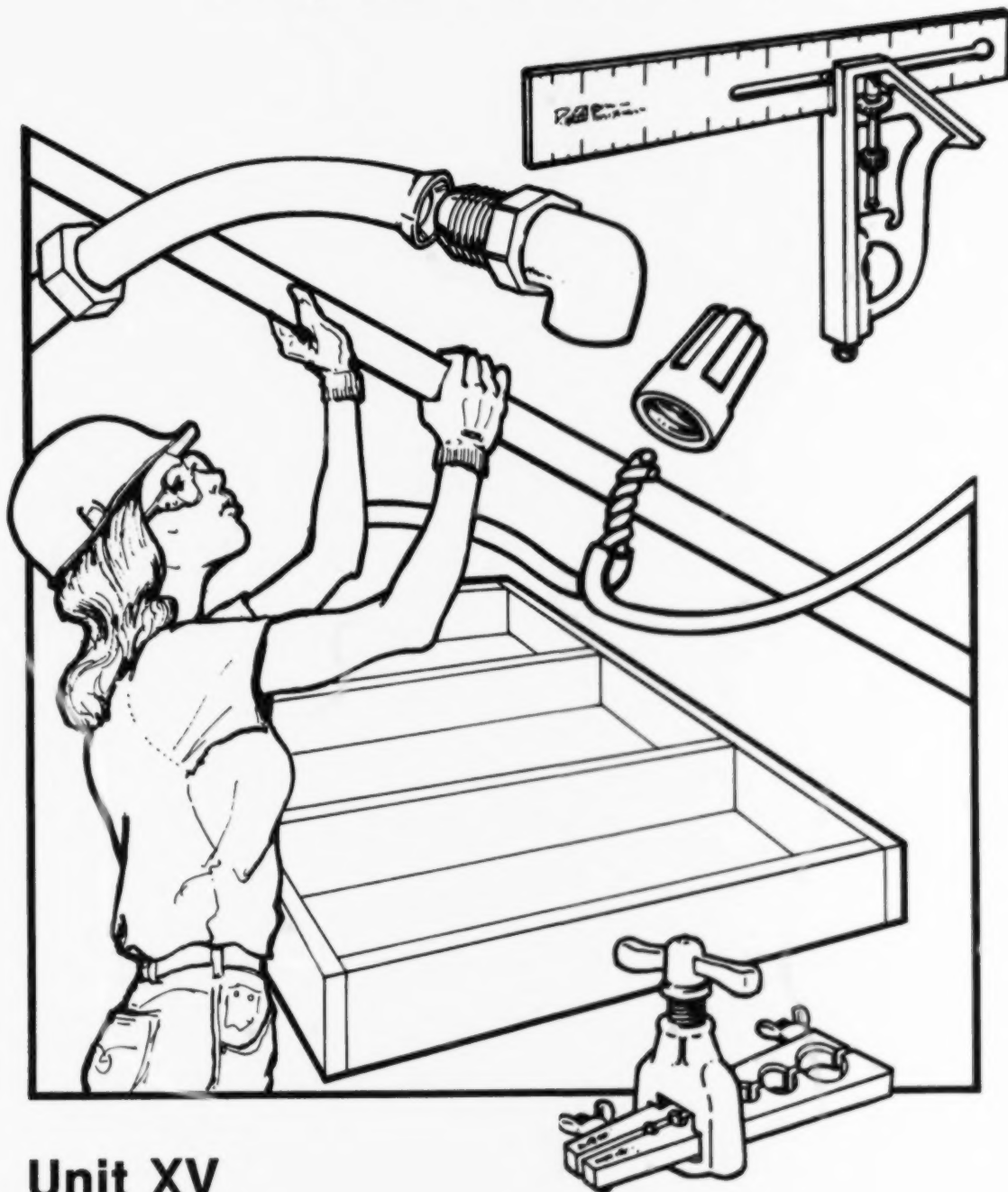
Should Move On ☐

Repeat This Unit ☐

Student's Signature/Date

Instructor's Signature/Date

337



Unit XV

Wiring a Switch

338

Building Trades - Electrical Construction
Wiring a Switch

Wiring a Switch

After studying this unit, you will be able to:

1. Identify tools and materials needed to wire a switch.
2. Install and wire a switch.

Check the Statement that Fits You Best

☐

I can do these tasks and want to go through the Performance Checklist.



SEE YOUR INSTRUCTOR

☐

I want to study the information in this unit before I do the Performance Checklist.



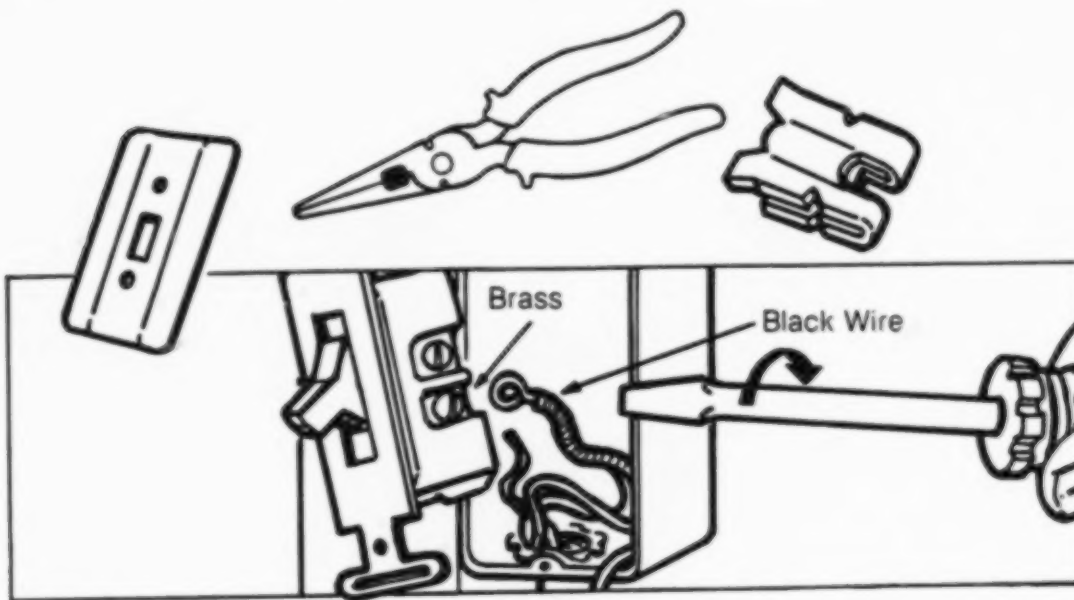
TURN PAGE AND BEGIN

Building Trades - Electrical Construction

Wiring a Switch

Introduction

Electrical wiring includes installing and wiring switches. A switch is used to turn electricity off and on at a certain point. You must know how to connect the wiring correctly so the switch will work properly.



In this unit, you will see how to wire a switch and see what equipment is needed to properly do the job.

TURN TO NEXT PAGE

Wiring a Switch

A. Terms and Equipment for Wiring a Switch

1. Loop - a half circle shape of wire
2. Mounting Screw - screw designed to fasten one thing to another
3. Pigtail - short length of wire for a connection
4. Switch - a device used to turn the flow of electricity off and on
5. Terminal Screw - brass screw on a switch

Building Trades - Electrical Construction

Wiring a Switch

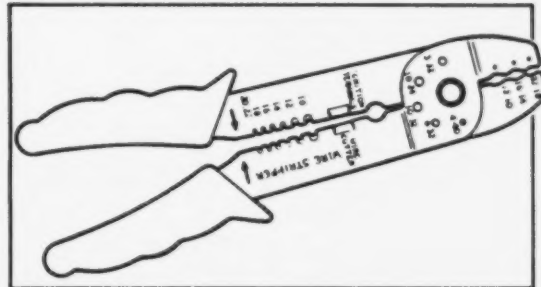
B. Steps for Wiring a Switch

1. Find the following tools and materials.

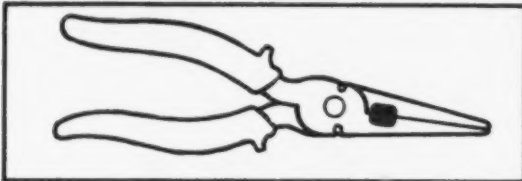
Safety Equipment



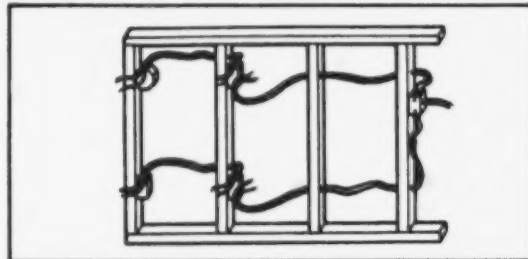
Wire Stripper



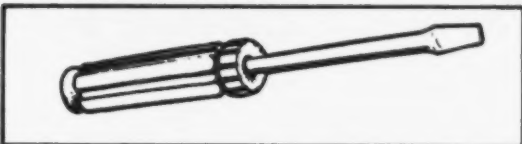
Long Nose Pliers



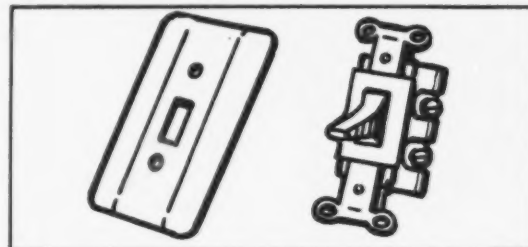
Wired Frame



Flathead Screwdriver



Switch and Cover Plate



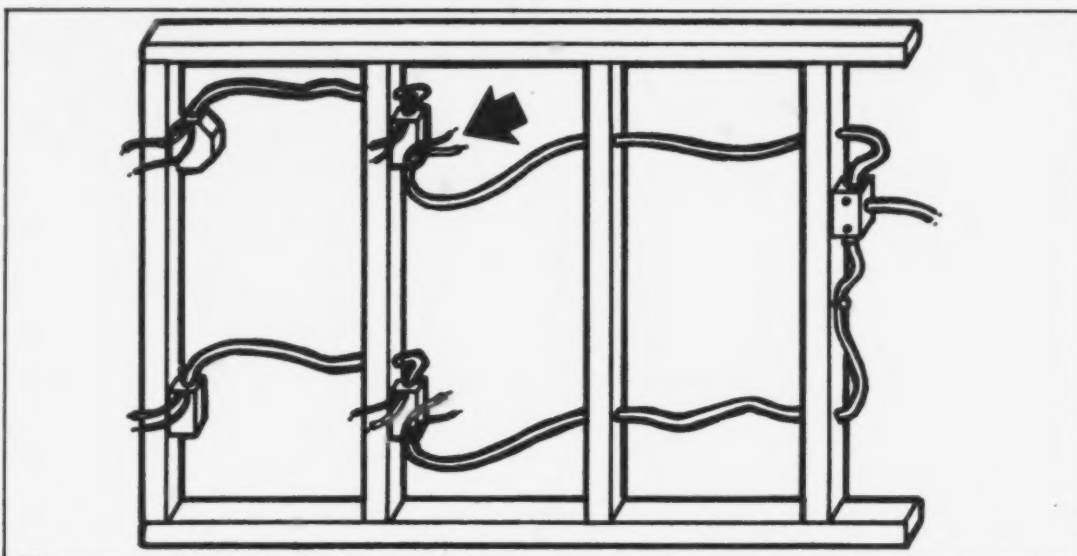
Grounding Clip



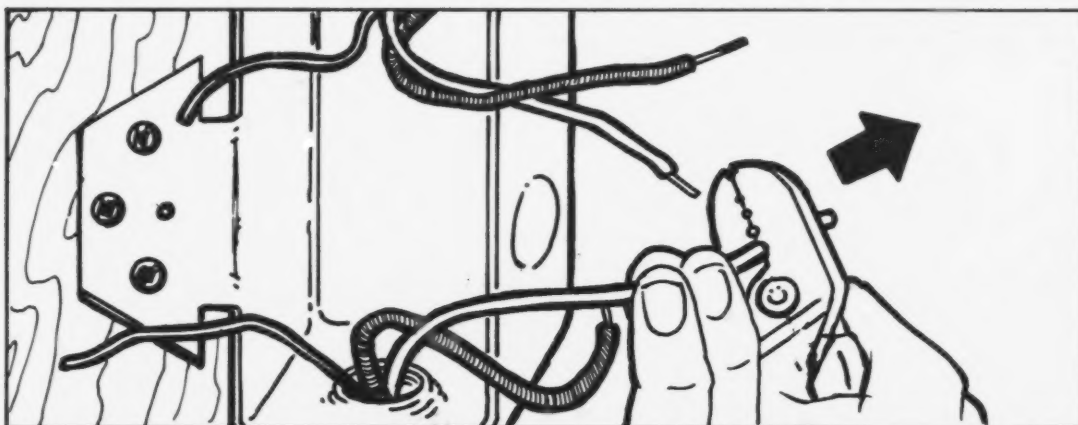
2. Put on safety glasses.



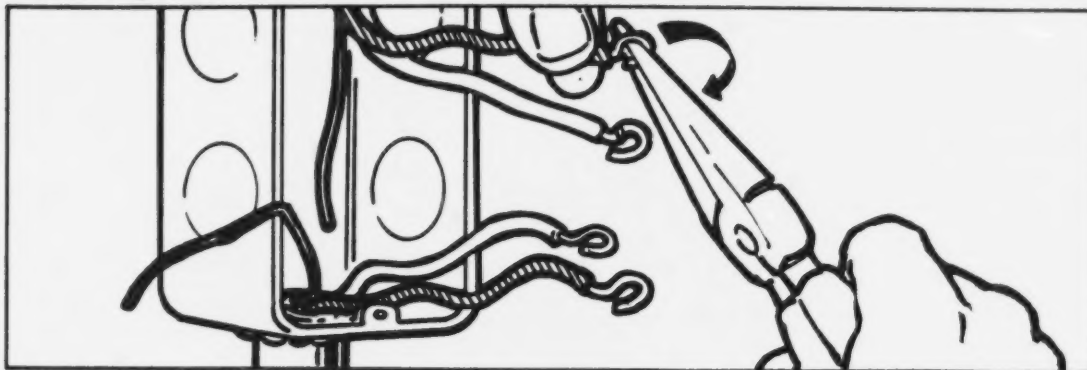
3. Locate the switch box on the building frame.



4. Strip $\frac{3}{4}$ " of insulation from each of the wires in the box.



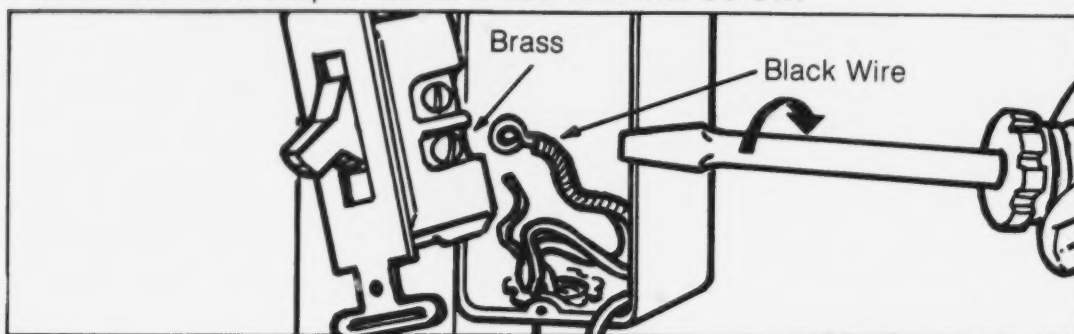
5. Use long nose pliers to bend stripped wires. Twist the bare ground wires together and shove them into box.



NOTE

Do not bend the bare ground wires.

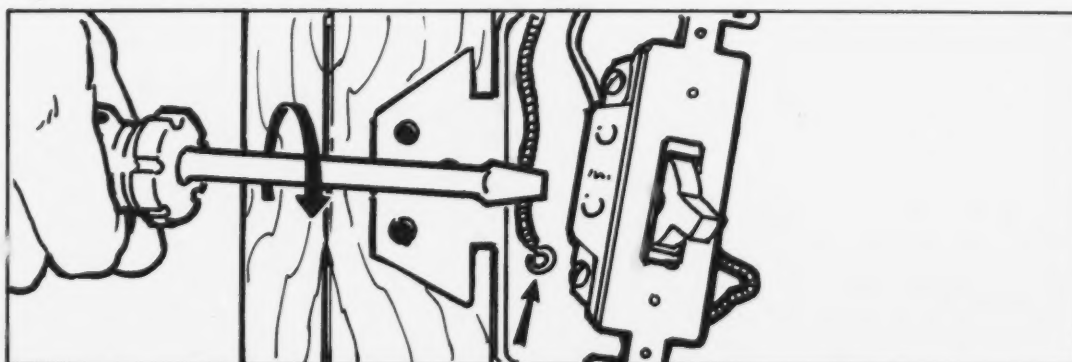
6. Place black wire loop under a brass terminal screw.



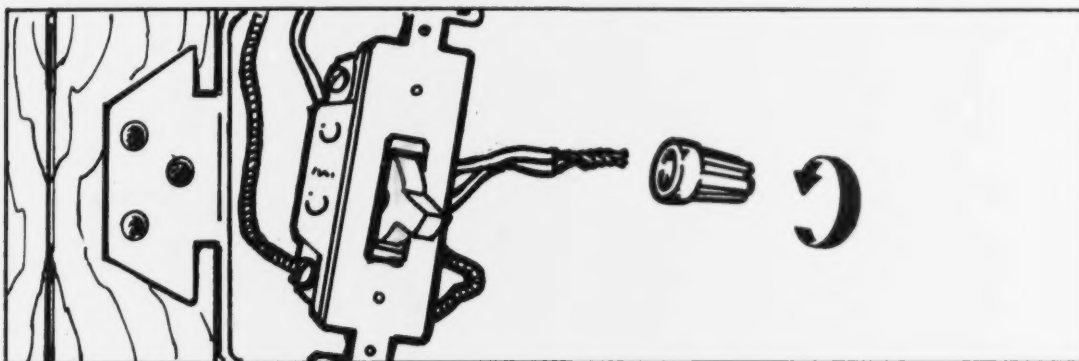
NOTE

Always turn the loop in the direction you will tighten the screw.

7. Tighten the screw.
8. Connect other black wire loop to the other brass screw.
9. Tighten the screw.

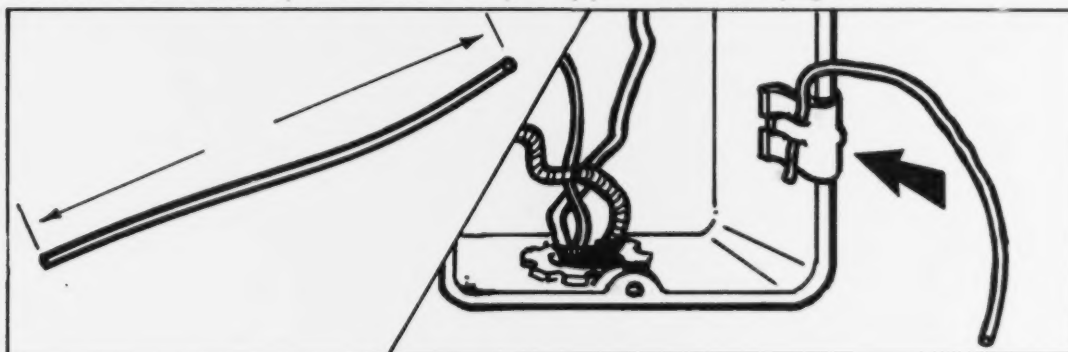


10. Twist the two white wires together.



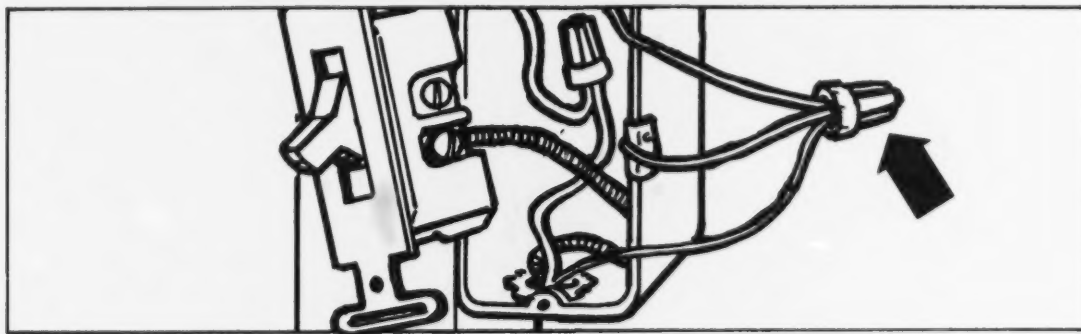
11. Connect them with a wire nut.

12. Obtain two 6 inch pieces of scrap copper wire for pigtails.



13. Make a loop at the end of one pigtail. Place the loop under the switch grounding screw.

14. Fasten the end of the other pigtail to the box with a grounding clip or screw.

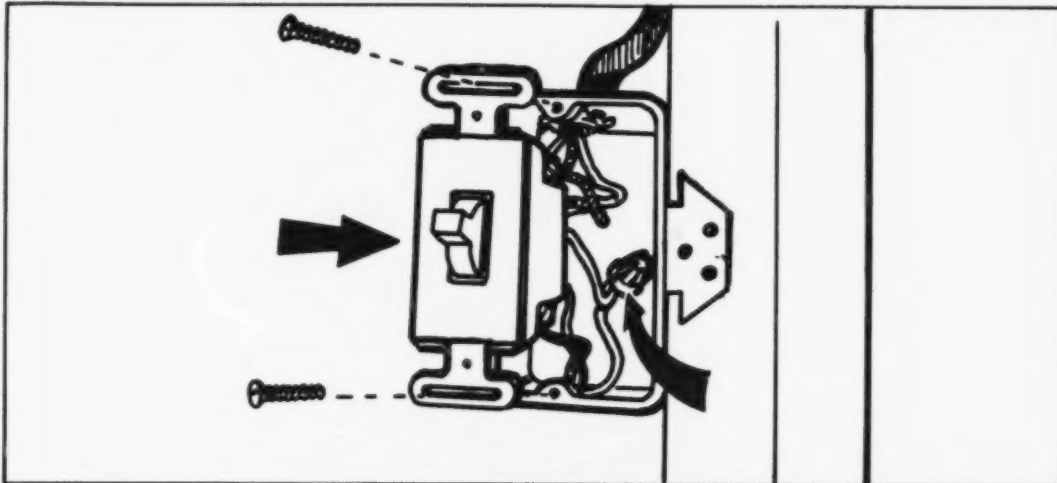


15. Twist the free ends of the pigtails to the two bare ground wires.

16. Join them with a wire nut.

17. Have your instructor check your work.

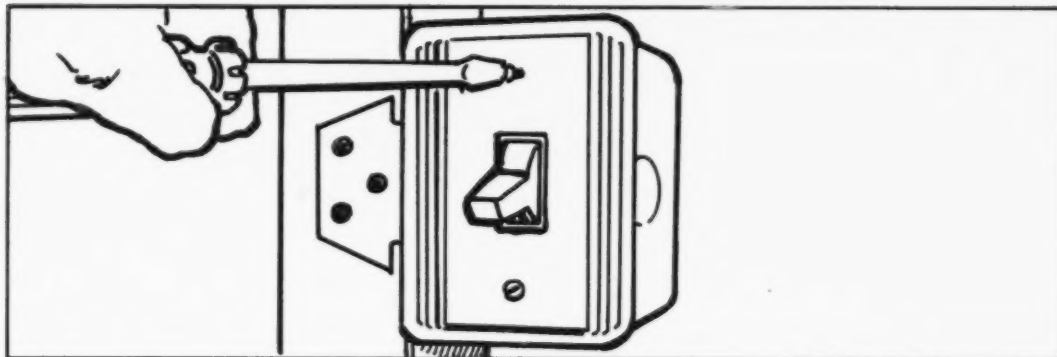
18. Fold the wires into the box. Install the switch in the box with two mounting screws.



NOTE:

Make sure the switch is vertical. The mounting screw slots are wide so you can adjust the switch.

19. Install the cover plate with the mounting screws.



20. Clean the work area. Return tools and equipment to their proper places.

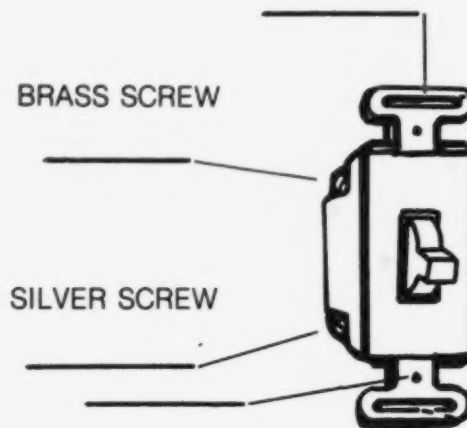
SEE YOUR INSTRUCTOR

Wiring a Switch

Unit Review

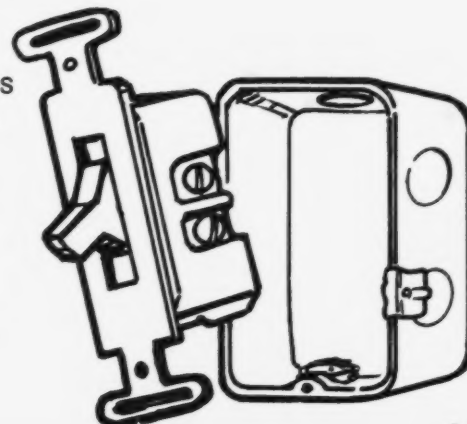
Directions: On the picture of a switch, put the number of the correct part in the blank by that part.

1. terminal screw
2. grounding screw
3. mounting screw slots
4. holes for mounting cover plate



Directions: Choose the best answer to make a true statement in each of the following sentences.

5. What color of wire should be fastened to the brass terminal?
 - a. bare wire
 - b. white wire
 - c. black wire
6. The two white wires are:
 - a. connected to the brass screws
 - b. joined together with a wire nut
 - c. fastened to the switch box
7. Which tools do you use to install a switch?
 - a. wire strippers, pliers, and screwdriver
 - b. cable ripper, drill, and hacksaw
 - c. voltage tester, pocket knife, and hammer
8. Draw white wires, black wires, and ground wires to show how to correctly connect a single pole switch.



Wiring a Switch

Performance Checklist

Student _____ has successfully performed the following steps of procedure.

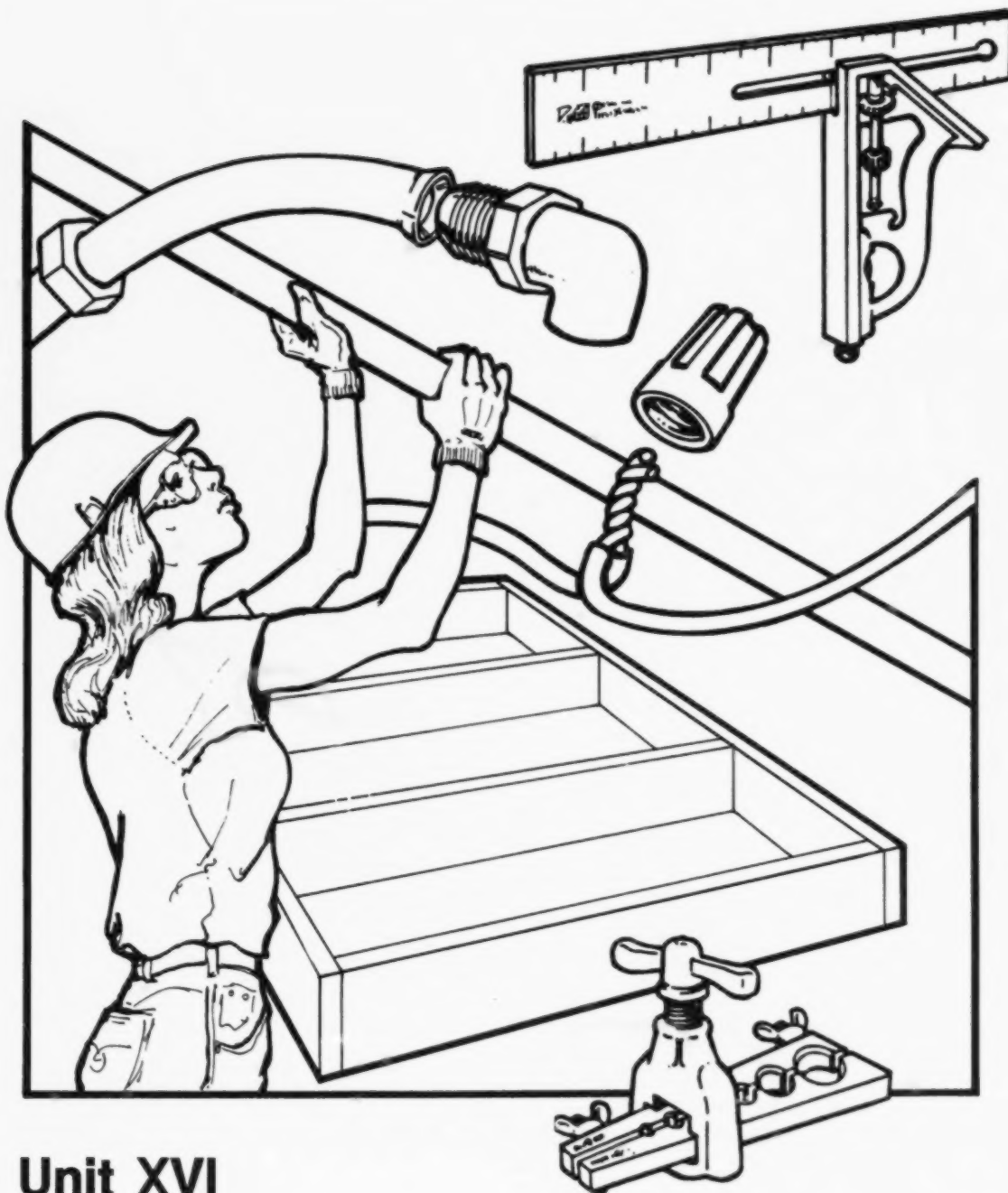
Wiring a Switch	Yes	No	Comments
1. Gathered necessary tools and equipment			
2. Put on safety equipment			
3. Stripped 3/4" of insulation from wires in box			
4. Twisted ground wires together			
5. Connected black wires to brass screw			
6. Twisted white wires together and applied wire nut			
7. Attached one pigtail to switch grounding screw			
8. Fastened another pigtail to box			
9. Twisted pigtails to the bare grounding wires			
10. Attached wire nut			
11. Folded wires into box			
12. Mounted switch in the box			
13. Installed cover plate			
14. Put away all tools and equipment			

Should Move On ☐

Repeat This Unit ☐

Student's Signature/Date

Instructor's Signature/Date



Unit XVI

Wiring an Outlet

Wiring an Outlet

Wiring an Outlet

After studying this unit, you will be able to:

1. Install and wire an outlet.

Check the Statement that Fits You Best

☐

I can do these tasks and want to go through the Performance Checklist.



SEE YOUR INSTRUCTOR

☐

I want to study the information in this unit before I do the Performance Checklist.



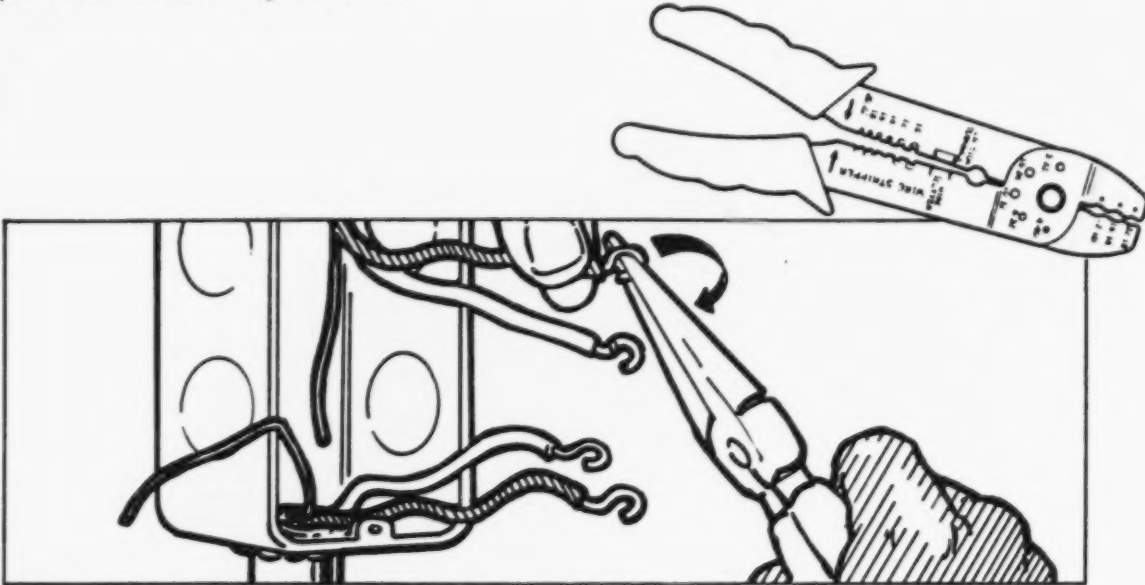
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Building Trades - Electrical Construction

Wiring an Outlet

Introduction

In this unit you will be connecting an electrical outlet to the electrical cable. This is one of the most common and most important wiring tasks done by an electrician. This method of wiring used in this unit is called parallel wiring. It is more often used because it provides more than one path for electricity to flow.



In this unit, you will learn how to wire an outlet and see the tools and materials needed to correctly do the job.

TURN TO NEXT PAGE

Wiring an Outlet

A. Terms and Equipment for Wiring an Outlet

1. Parallel Wiring - most commonly used method of wiring because it provides more than one path for electricity to follow.

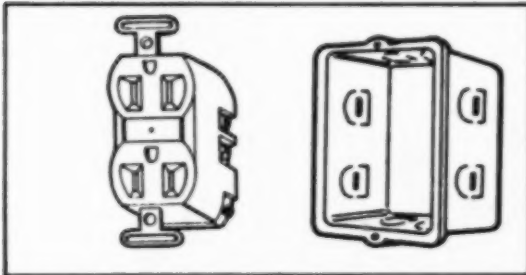
Building Trades - Electrical Construction

Wiring an Outlet

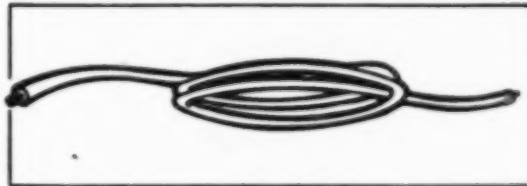
B. Steps for Wiring an Outlet

1. Find the following tools and materials.

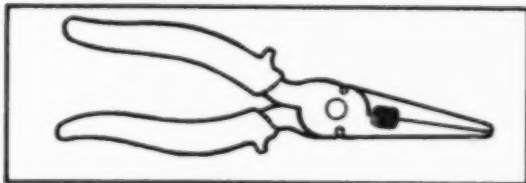
Outlet Assemblies



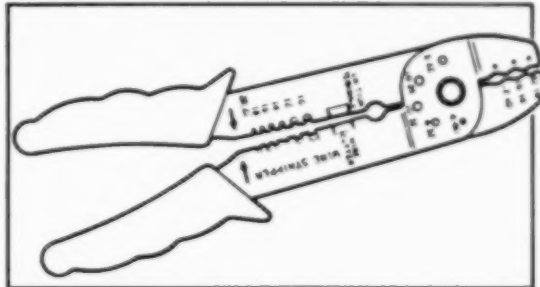
Ground Wire



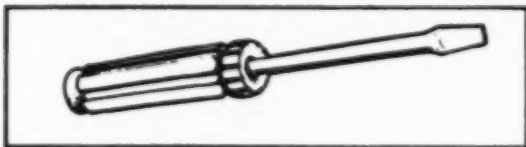
Long Nose Pliers



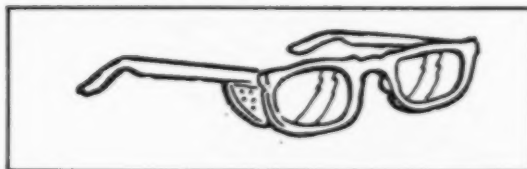
Wire Stripper



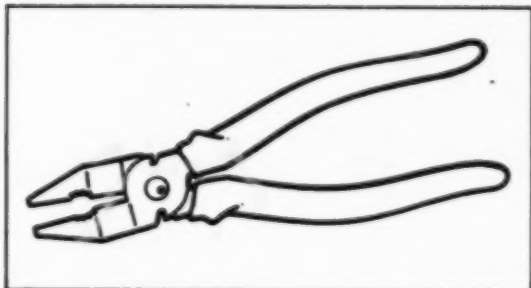
Flathead Screwdriver



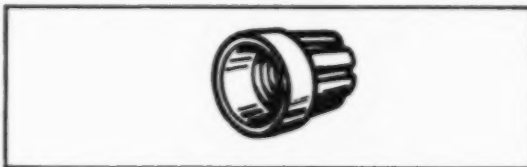
Safety Glasses



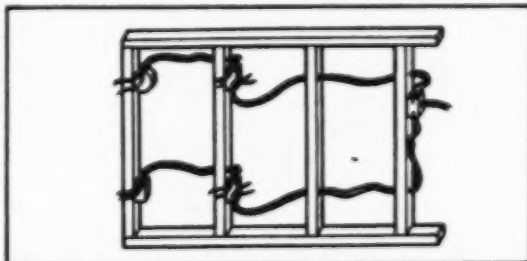
Side Cutting Pliers



Wire Nuts



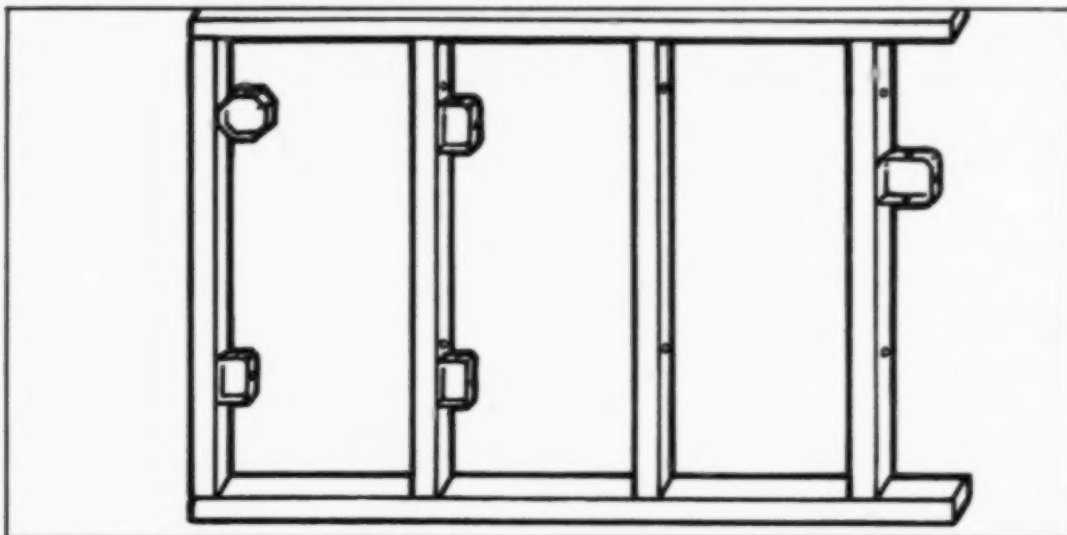
Wired Frame



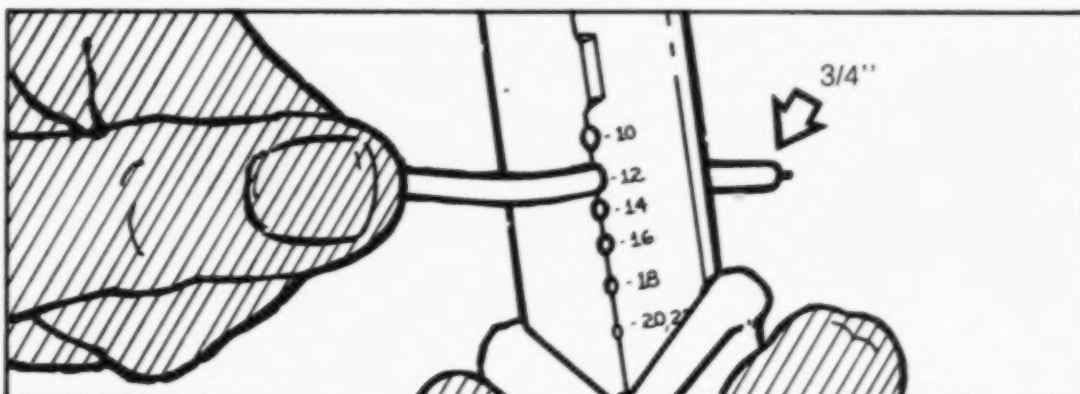
2. Put on safety glasses.



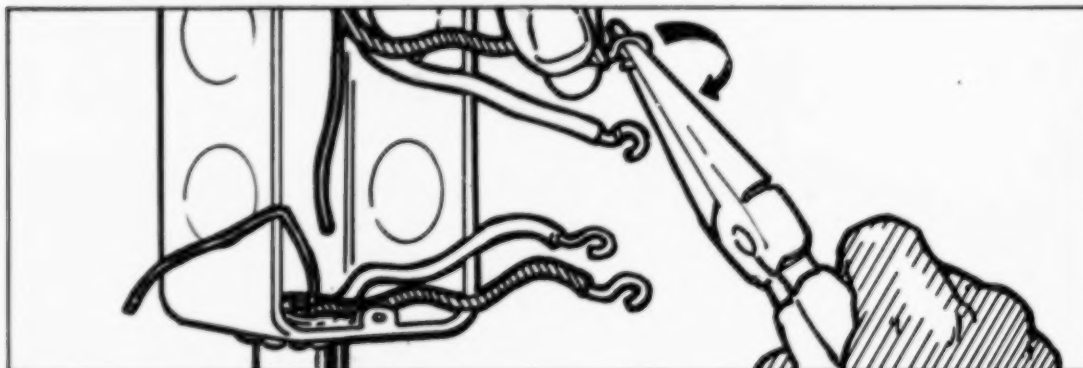
3. Locate the bottom two outlet boxes on the frame.



4. Strip $\frac{3}{4}$ " of insulation from each of the black and white wires.



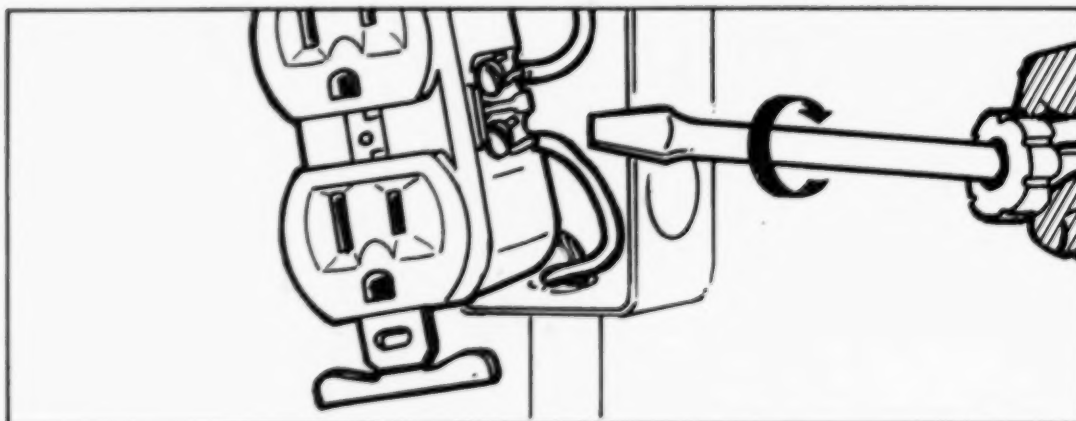
5. With the long nose pliers, bend the bare wire ends into loops. (Two white and two black for each outlet box).



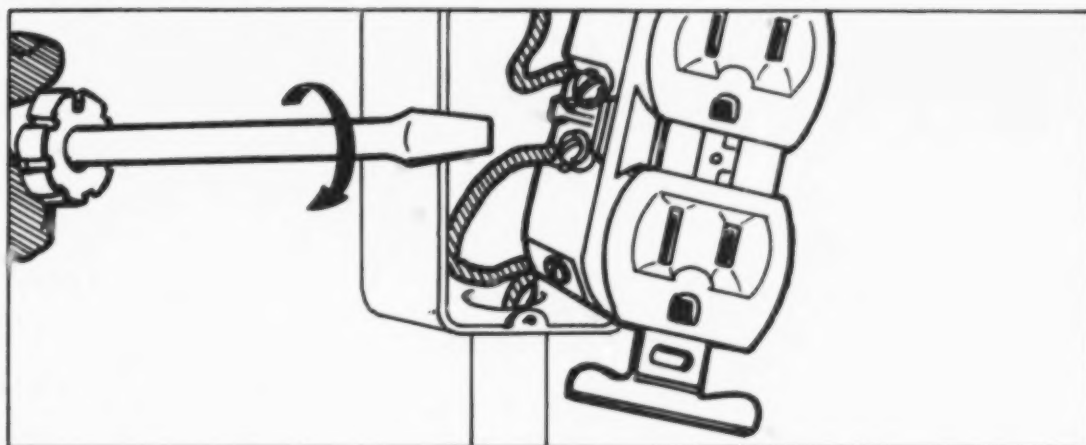
NOTE

Always point the wire loop in the direction that the screw turns.

6. Place the loops of the black wires under the brass screws on the outlets. Tighten the screws.



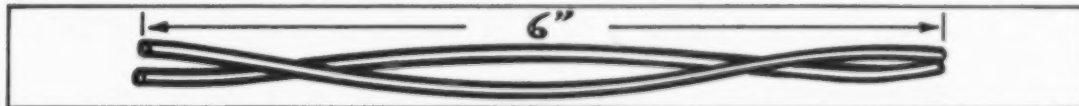
7. Place the white wire loops under the aluminum screws. Tighten the screws.



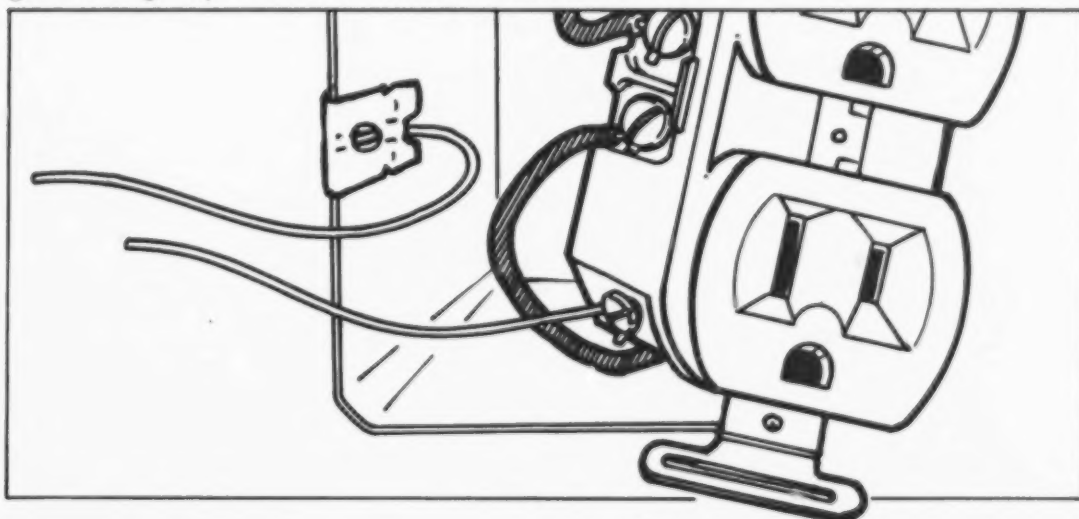
NOTE

Always attach the black wire to the brass screw and the white wire to the aluminum screw. The green screw always takes the ground wire.

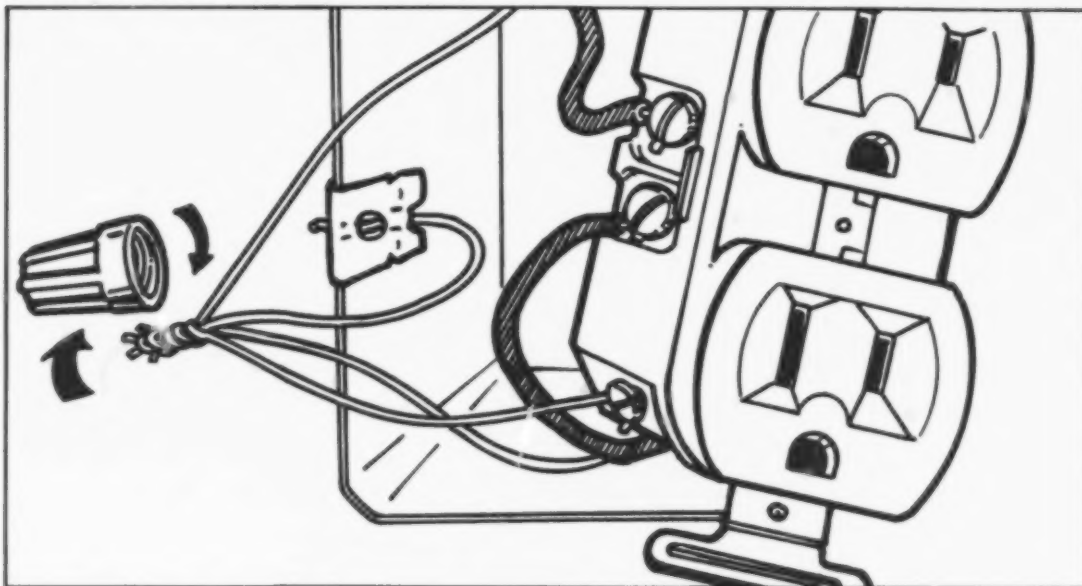
8. Cut two six inch pieces of bare ground wire for each outlet box. These are called pigtails.



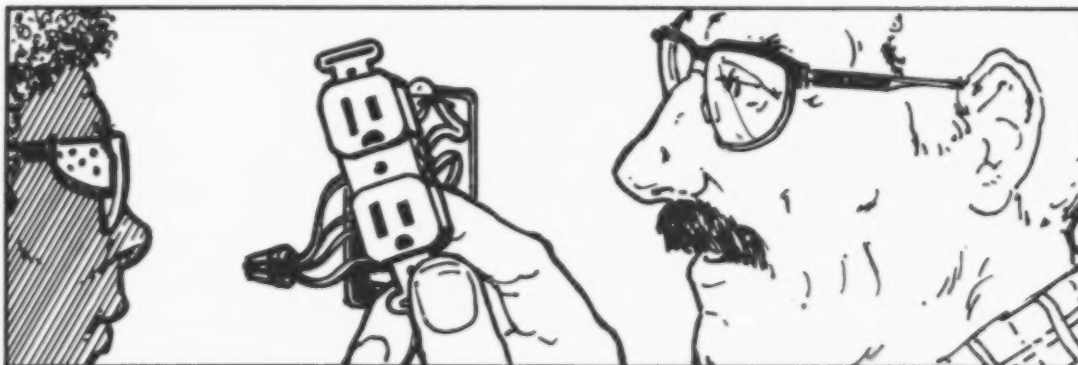
9. Loop and connect the end of one piece to the green screw. Do this on both outlets. Tighten the screws.
10. Connect the end of the other piece to the outlet box with a grounding clip. Do this on both boxes.



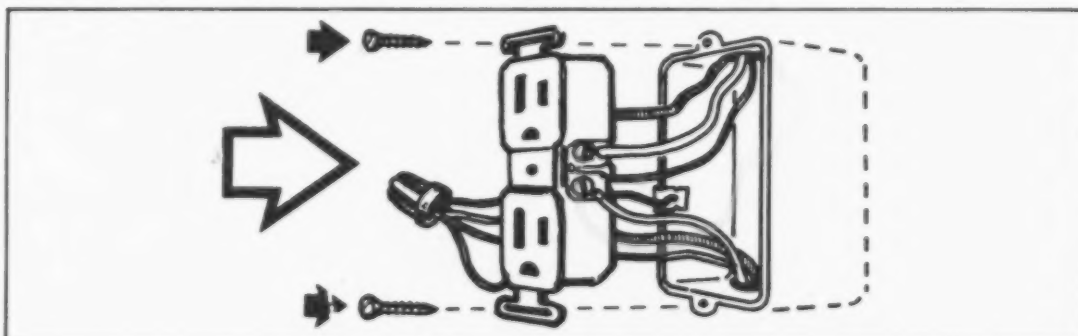
11. Use side cutting pliers to twist the ground wires (4) together. The end box will have only three ground wires.
12. Connect them with a wire nut.



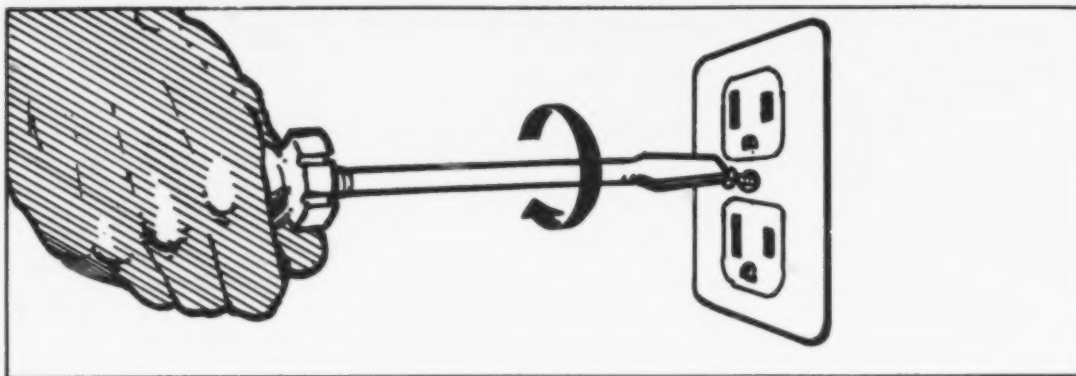
13. Have your instructor check your wiring connections.



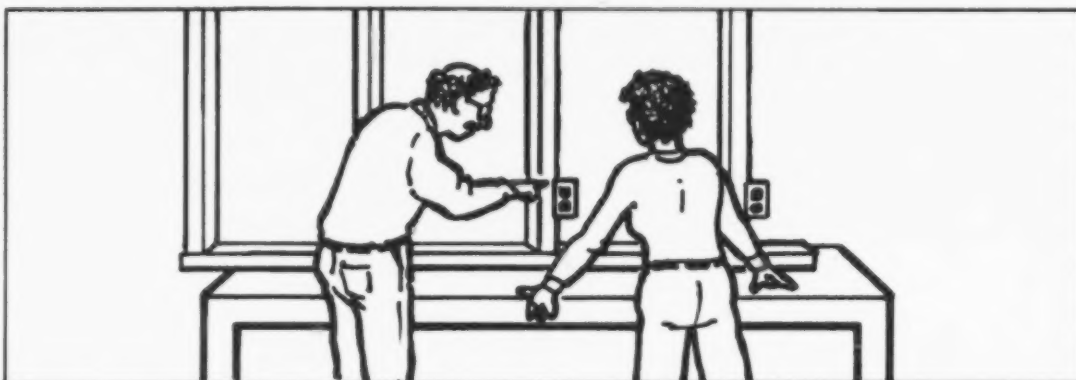
14. Tuck the wires into the boxes.
15. Secure the outlets to the boxes with their screws.



16. Attach each cover plate.



17. Have your instructor check the finished work with you.



18. Clean your work area and return all tools and materials to their proper places.

SEE YOUR INSTRUCTOR

Wiring an Outlet

Unit Review

Directions: Circle the letter in front of the word or statement that makes the sentence true.

1. Connect the black wires to the:
 - a. aluminum screws
 - b. brass screws
 - c. green screw
2. Connect the white wires to the:
 - a. aluminum screws
 - b. brass screws
 - c. green screw
3. Connect the ground wire to the:
 - a. aluminum screws
 - b. brass screws
 - c. green screw
4. The six inch copper wires are called:
 - a. pigtails
 - b. short connectors
 - c. grounding terminals
5. A tool used to tighten wires to the outlet is a:
 - a. pair of pliers
 - b. wire stripper
 - c. screwdriver
6. Bend the wire loops in the direction:
 - a. that the screws turn
 - b. opposite the way the screws turn
 - c. that the wall faces
7. The long nose pliers are used to:
 - a. twist the ground wires together
 - b. attach wire nuts
 - c. bend the wire ends into loops

8. Parallel circuits have:
 - a. only one path for current to flow
 - b. more than one path for current to flow
 - c. two receptacles for each circuit
9. Outlets are secured to the boxes with:
 - a. wire splices
 - b. screws
 - c. nails
10. What is one of the last steps in wiring an outlet?
 - a. stripping the wire
 - b. connecting the ground wires with a wire nut
 - c. attaching the cover plate

360

Wiring an Outlet

Performance Checklist

Student _____ has successfully performed the following steps of procedure.

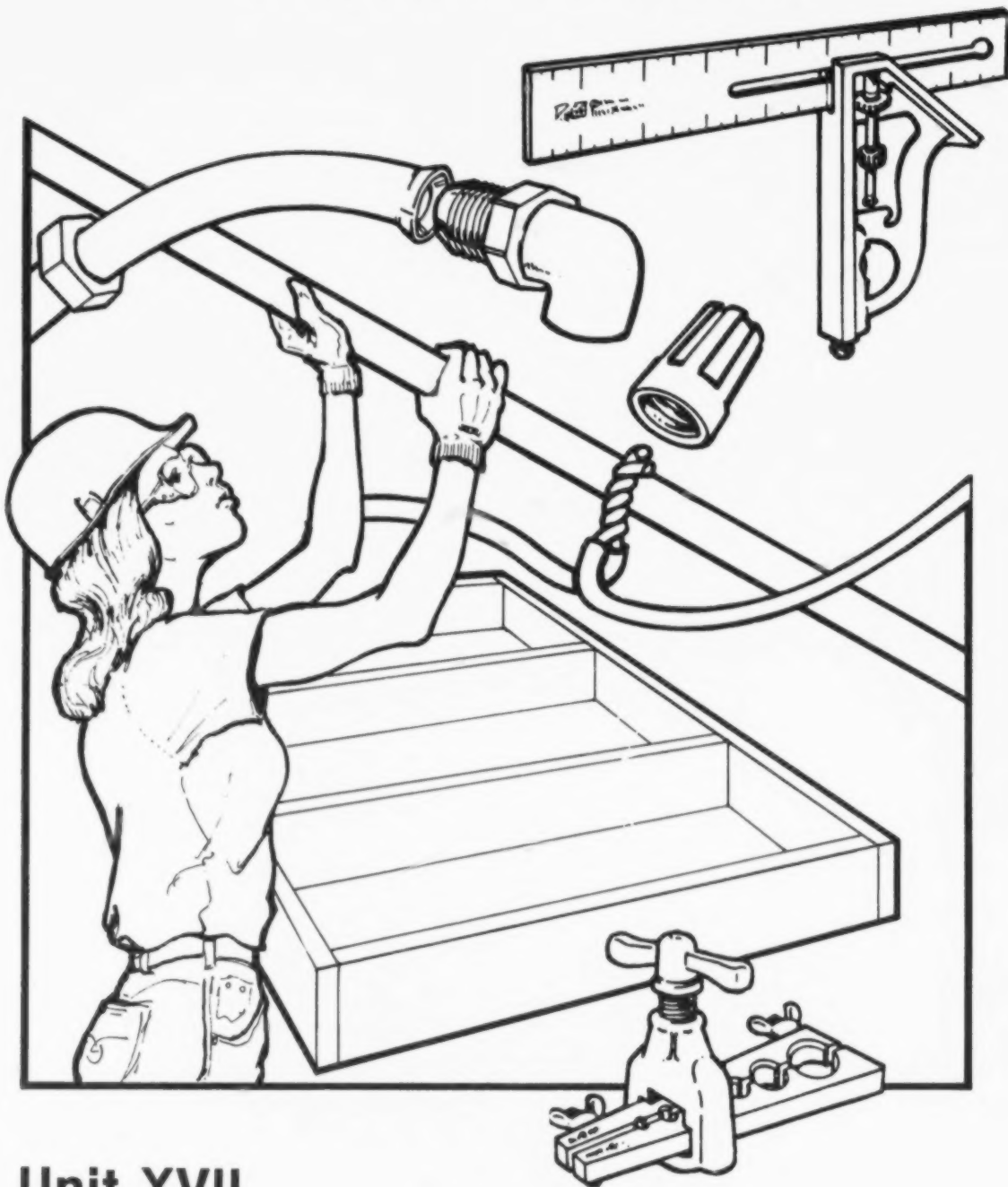
Installing and Wiring an Outlet	Yes	No	Comments
1. Gathered necessary tools and equipment			
2. Put on safety glasses			
3. Located outlet boxes			
4. Stripped 3/4" of insulation from wires			
5. Bent ends of wires into loops			
6. Fastened the black wire under the black screw			
7. Fastened the white wire under the aluminum screw			
8. Fastened the ground wire to the green screw			
9. Connected another pigtail to the outlet box			
10. Twisted ground wires together			
11. Connected ground wires with a wire nut			
12. Tucked wires into box			
13. Screwed outlet to box			
14. Attached cover plate			
15. Cleaned work area and put away tools and supplies			

Should Move On ☐

Repeat This Unit ☐

Student's Signature/Date

Instructor's Signature/Date



Unit XVII

Installing Light Fixtures

Building Trades - Electrical Construction

Installing Light Fixtures

Installing a Light Fixture

After studying this unit, you will be able to:

1. Identify tools and materials needed to install a light fixture.
2. Install and wire a light fixture.

Check the Statement that Fits You Best

☐

I can do these tasks and want to go through the Performance Checklist.



TURN PAGE AND BEGIN

☐

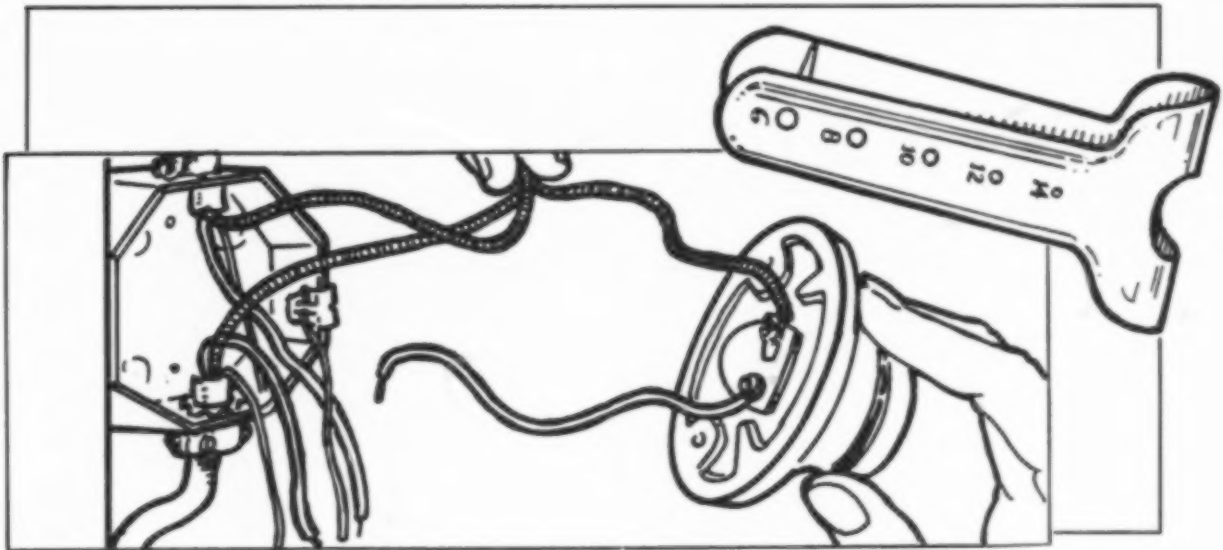
I want to study the information in this unit before I do the Performance Checklist.



SEE YOUR INSTRUCTOR

Introduction

The electric light is the most visible part of the wiring system in a finished house. Parallel wiring is used in houses because it provides more than one path for current flow. If one light is removed from a parallel path the current will flow through the other paths. In this unit you will learn to install light fixtures controlled by one switch.



TURN TO NEXT PAGE

Installing Light Fixtures

A. Light Fixtures - Terms

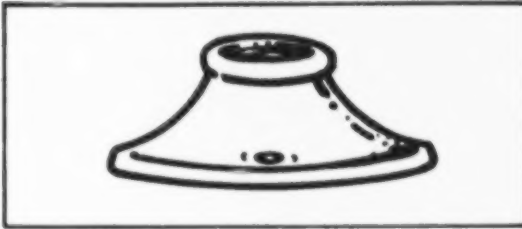
1. Alligator Clip - A clip whose jaws look like an alligator's mouth when opened - part of a continuity tester
2. Continuity Tester - tests for electrical paths that are not broken
3. Continuous - not broken
4. Controlled - operated
5. Mount - to fix in place, to attach, to fasten
6. Power Supply Cord - a cable that has a 3-prong plug and a green grounding wire - used to bring power to an appliance from an outlet
7. Probe - a thin metal needle used to touch things - one end of a continuity tester
8. Visible - part you can see

Building Trades - Electrical Construction
Installing Light Fixtures

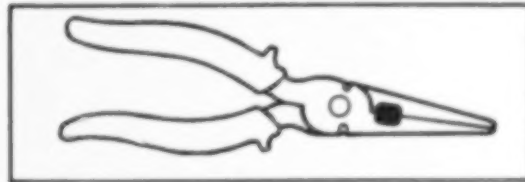
B. Steps for Installing a Light Fixture

1. Find the following tools and materials.

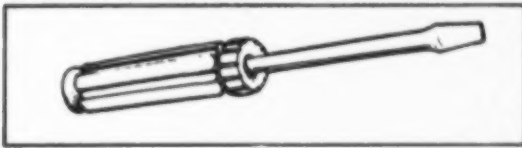
Porcelain Light Fixtures(2)



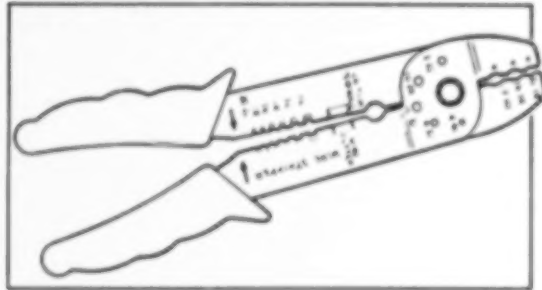
Long Nose Pliers



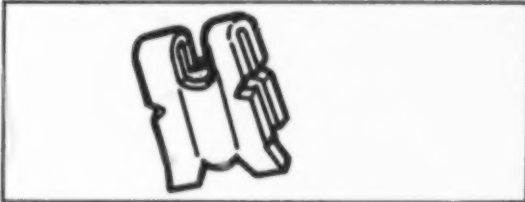
Flathead Screwdriver



Wire Stripper



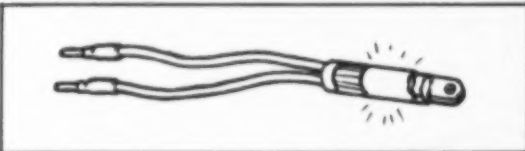
Grounding Clip



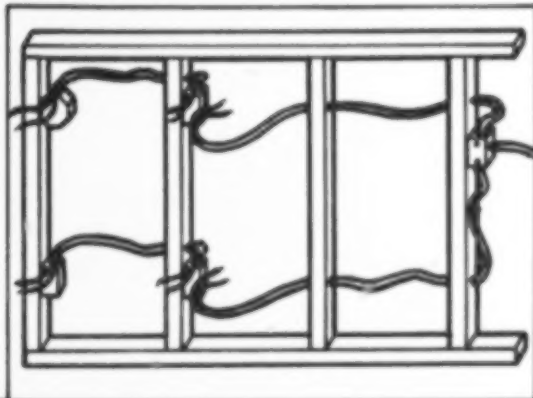
Safety Glasses



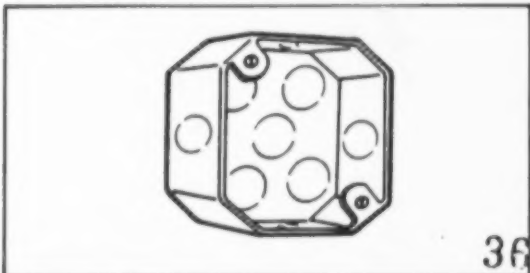
Continuity Tester



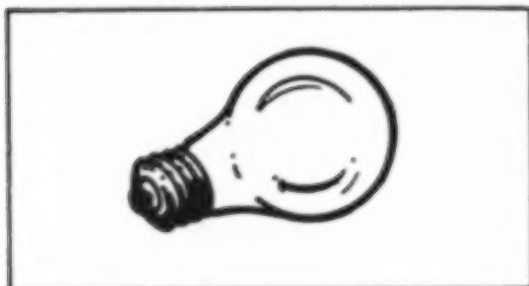
Wired Frame



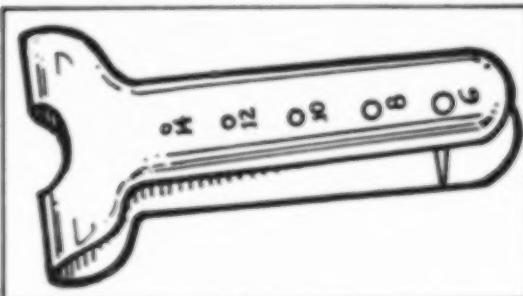
Octagon Box



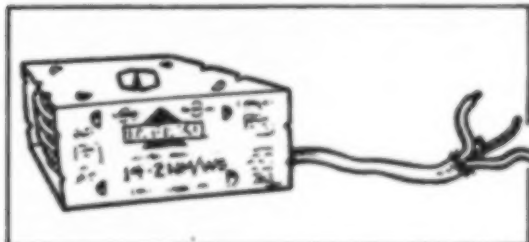
Light Bulbs(2)



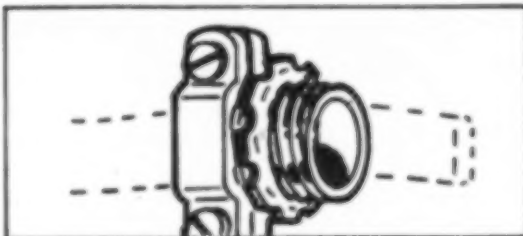
Cable Ripper



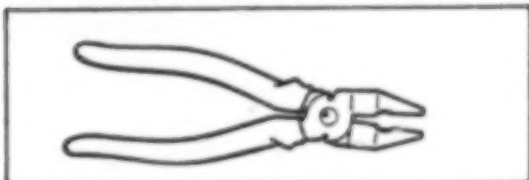
Grounded Cable



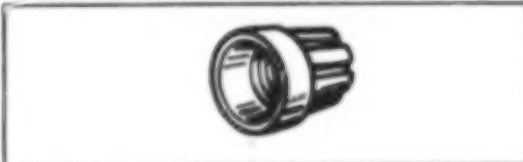
Cable Connectors(2)



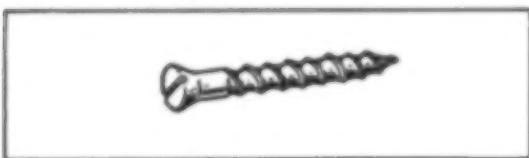
Side Cutting Pliers



Wire Nuts(2)



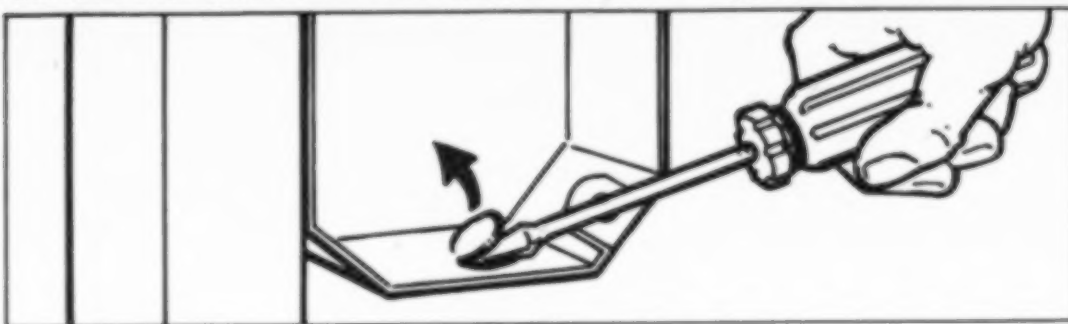
Wood Screws(2)



2. Put on safety glasses.

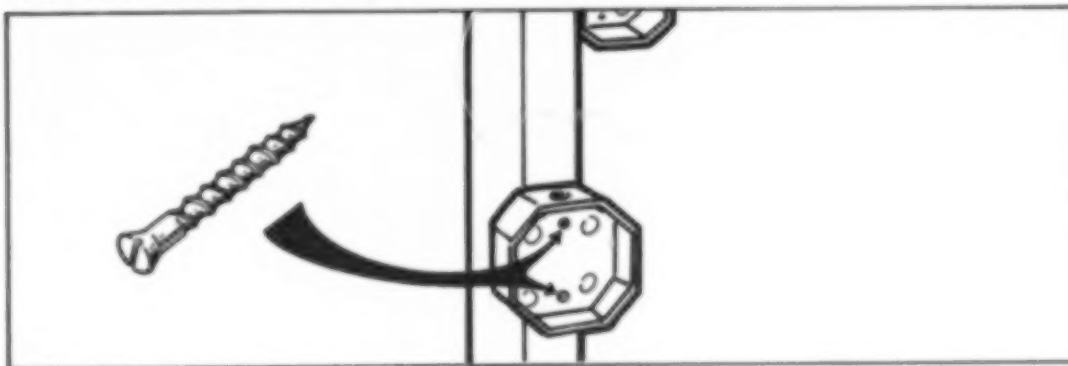


3. Remove the knockout in the bottom of the octagon box on the frame.

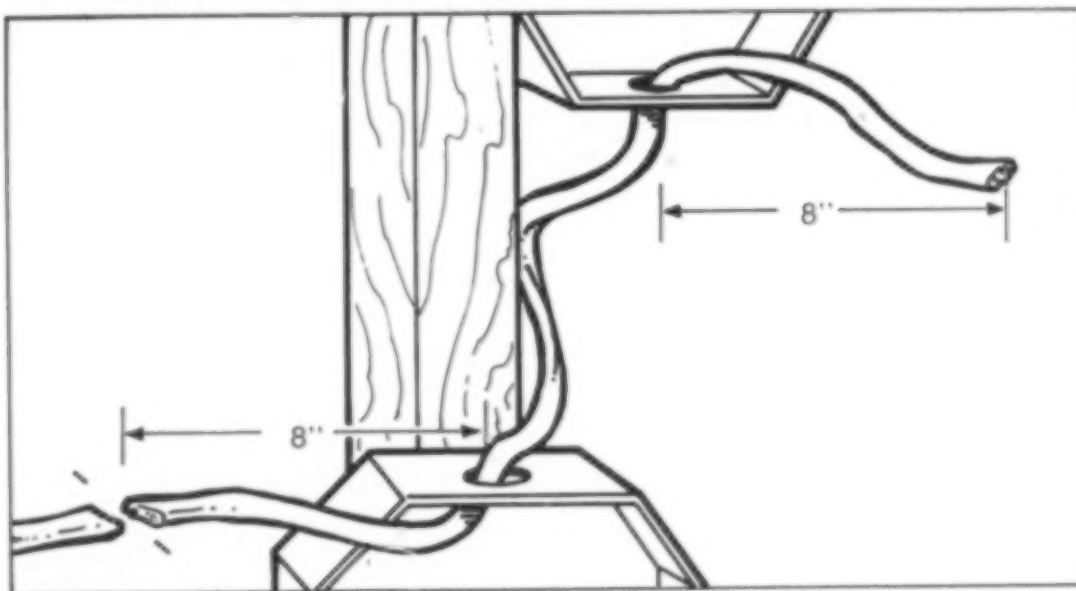


4. Find a second octagon box and remove the top knockout.

5. Mount the second octagon box on the front of the stud six to eight inches below the other box. Fasten with two wood screws through holes in the back of the box.



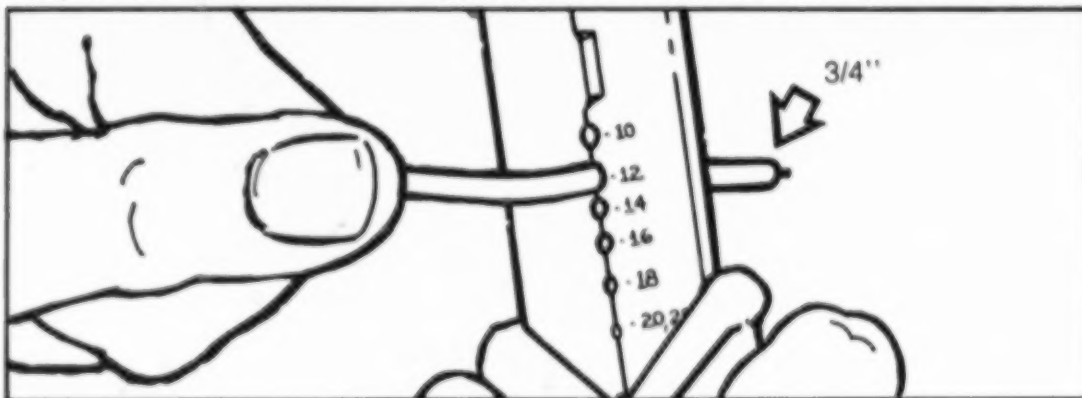
6. Run a piece of cable eight inches into the top octagon box and eight inches into the bottom one.



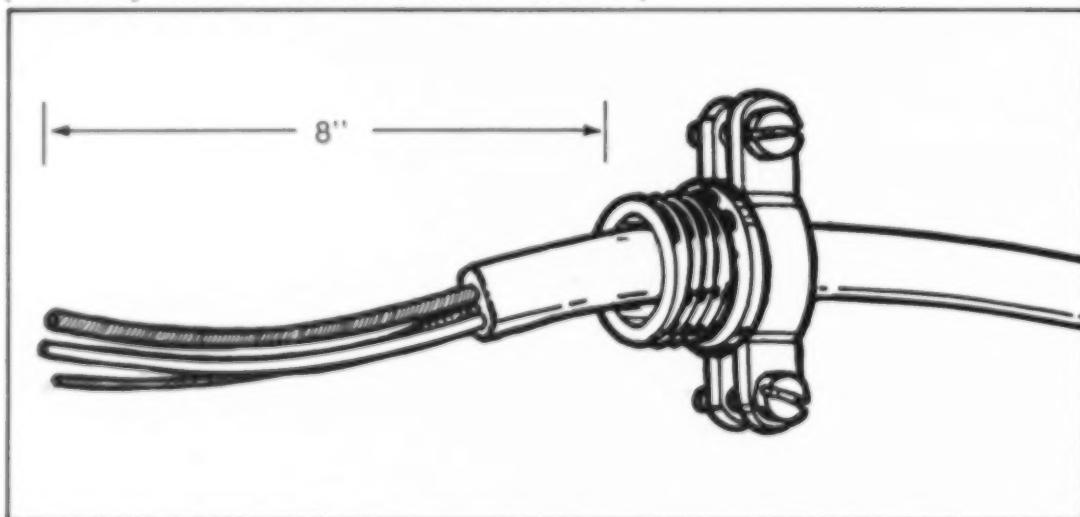
7. Cut the cable.
8. Remove six inches of outer insulation from each end of the cable.



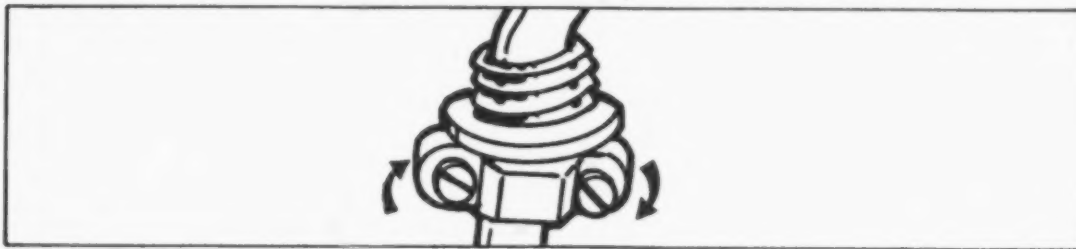
9. Cut off the paper strips.
10. Strip three-fourths inch of insulation from each of the wire ends.



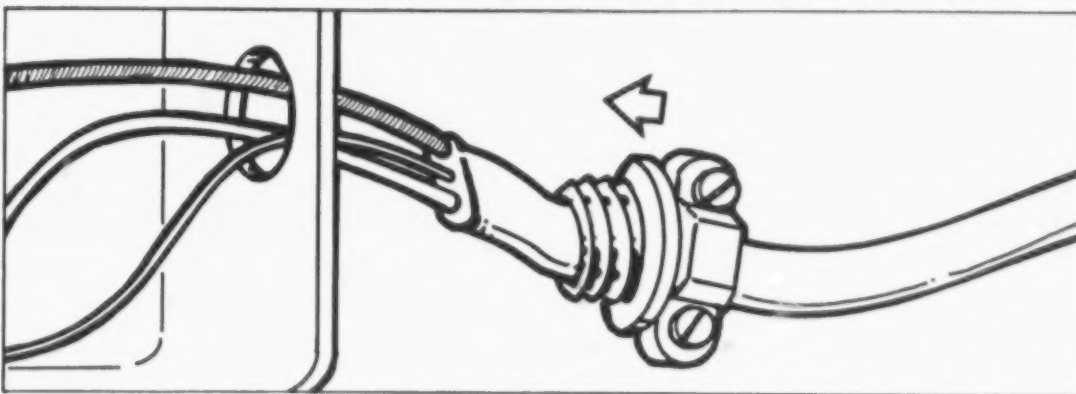
11. Pull the cable from the top octagon box.
12. Find a cable connector. Remove the locknut from the bushings.
13. Slip the connector bushing over the cable wires about eight inches. (You may have to loosen the two screws.)



14. Tighten the two bushing screws to clamp it onto the cable.



15. Place the cable connector through the knockout hole in the box.

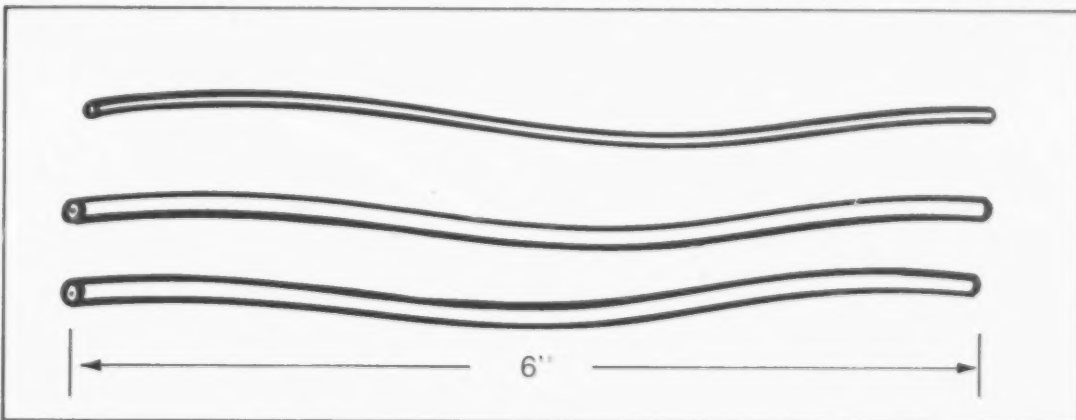


16. Place the locknut over the wires and tighten it to the bushing.

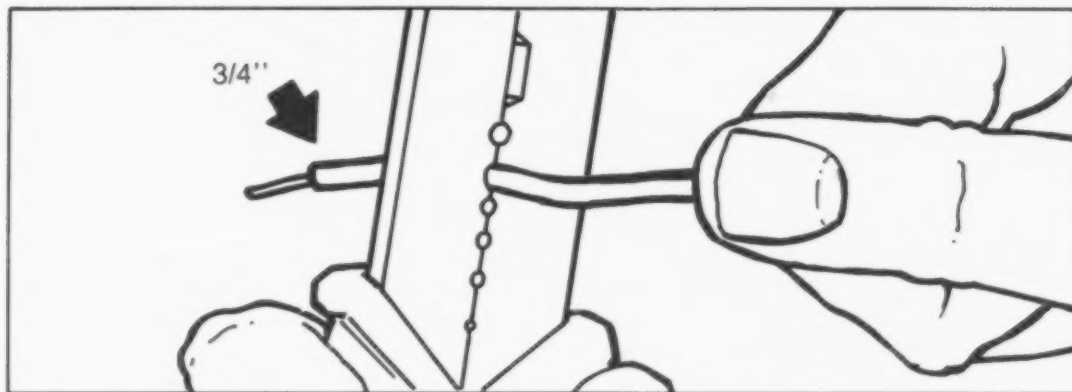
17. Secure the cable in the bottom octagon box with a cable connector.



18. Cut six inch pigtails of black, white, and ground wire.(One of each.)

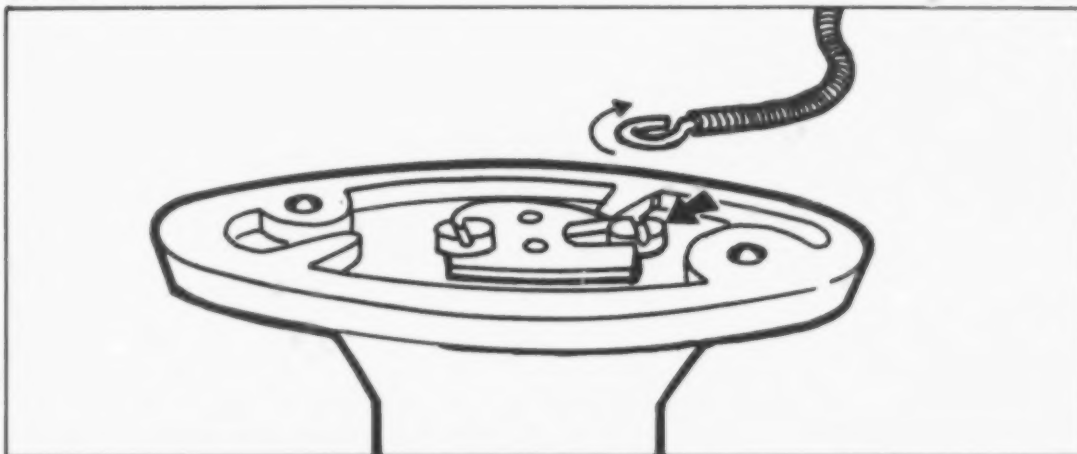


19. Strip 3/4" of insulation from each end of the black and white pigtails.



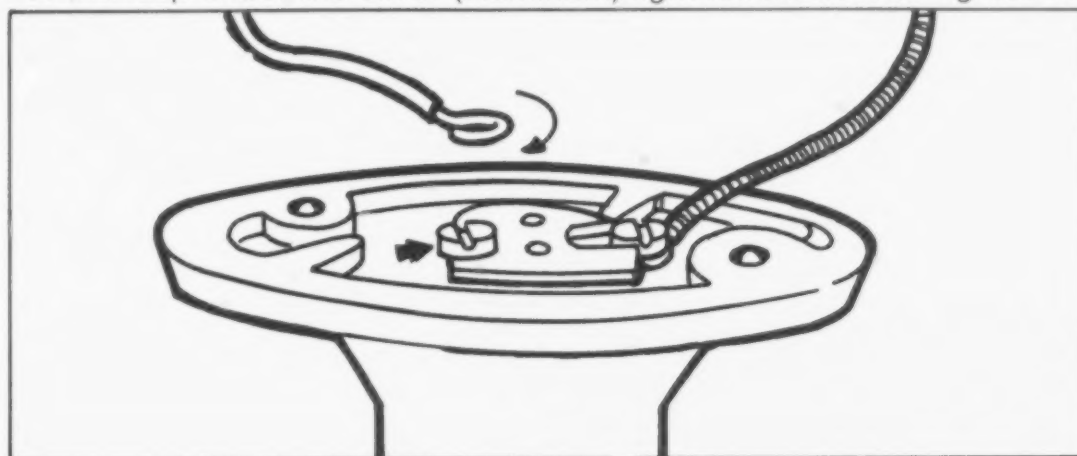
20. Bend one end of the black pigtail into a loop.

21. Put the loop under the brass screw on a light fixture. Tighten the screw.

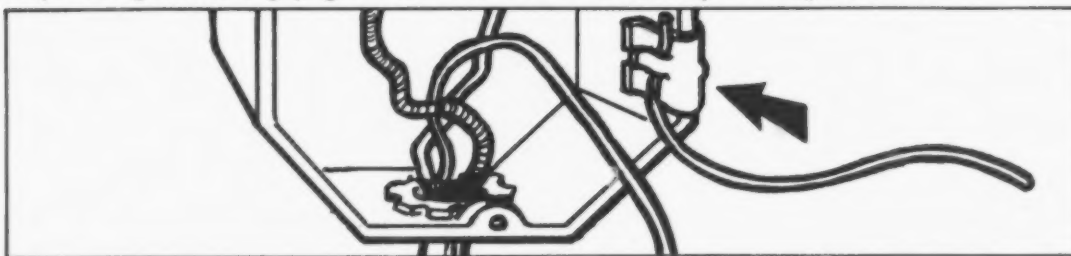


22. Bend one end of a white pigtail into a loop.

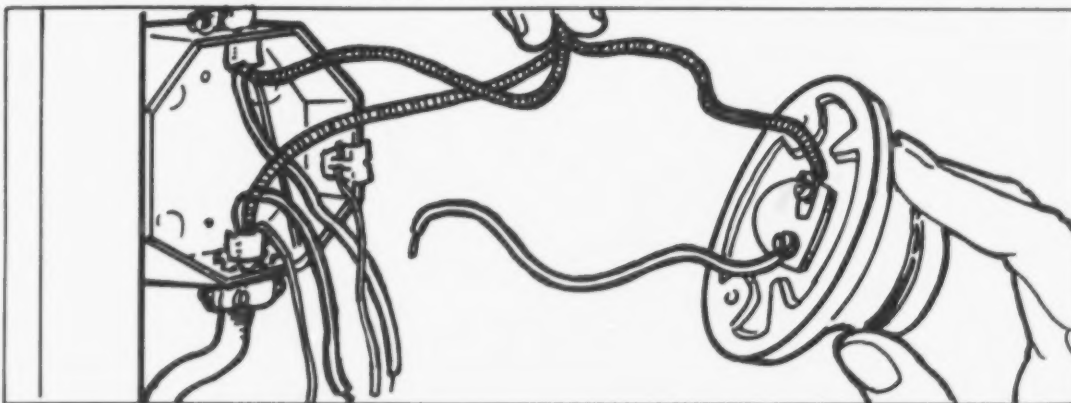
23. Put the loop under the silver (aluminum) light fixture screw. Tighten it.



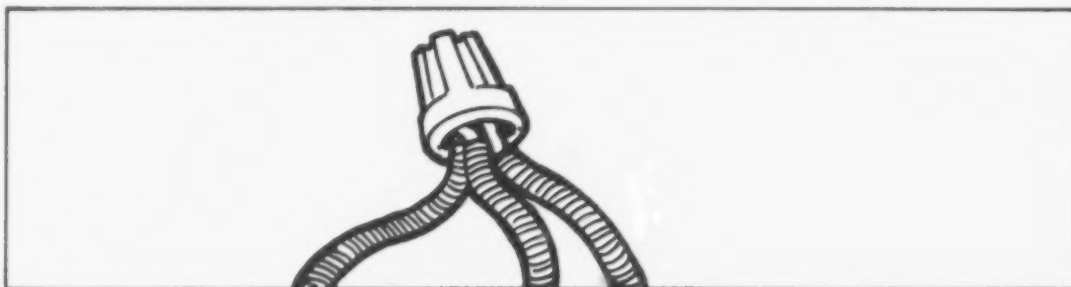
24. Clip the grounding pigtail to the side of the top octagon box.



25. Hold the fixture with the pigtails. Pull the two black wires from the top box together with the black wire on the fixture.



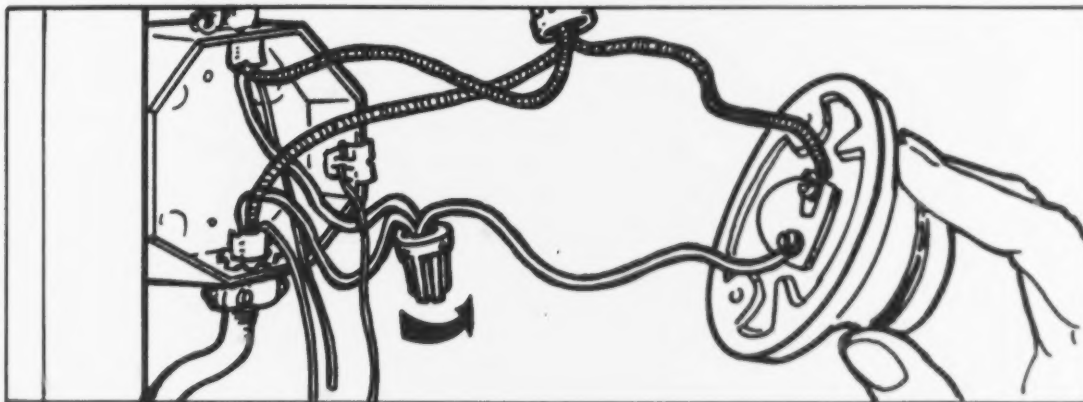
26. Twist the black wires together. Connect them with a wire nut.



27. Pull the two white wires and the white pigtail together.

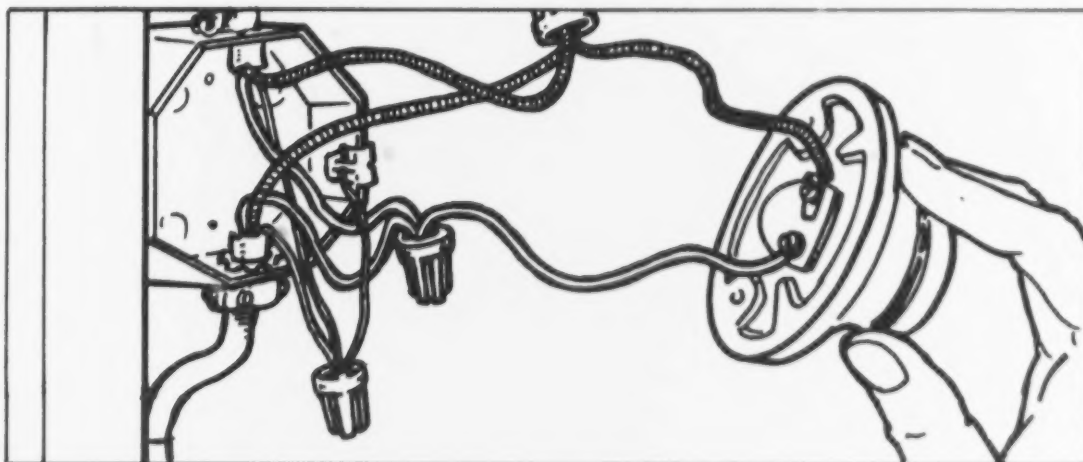


28. Twist them together. Connect them with a wire nut.

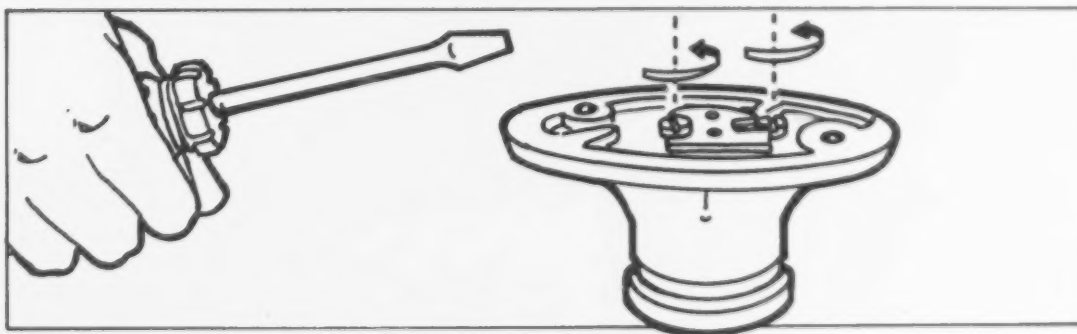


29. Pull the three ground wires together.

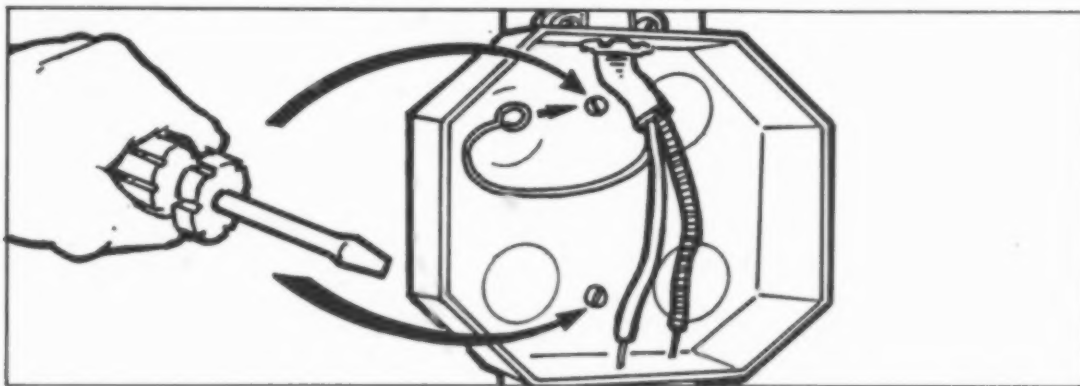
30. Twist them together. Connect them with a wire nut.



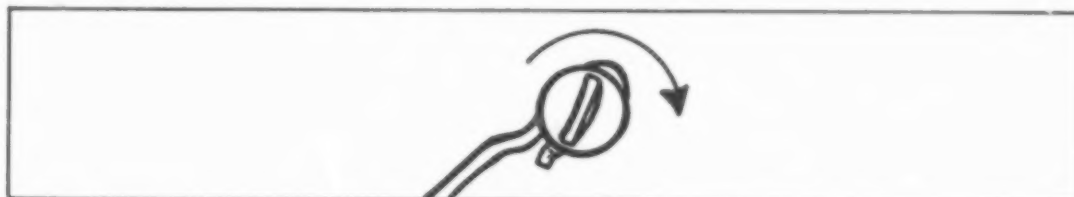
31. Loosen the screws on the back of the bottom fixture.



32. Bend the end of the ground wire into a loop.



33. Put the loop under one of the wood screws holding the box to the stud. Tighten the screw.



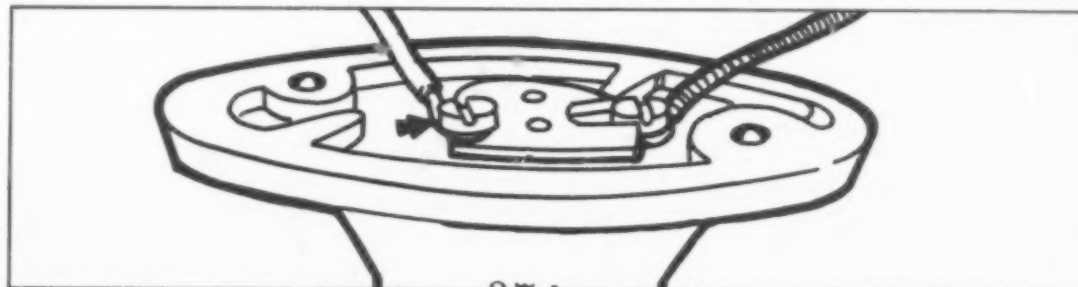
34. Bend the end of the white wire into a loop.

35. Place the loop under the silver screw on the fixture. Tighten the screw.

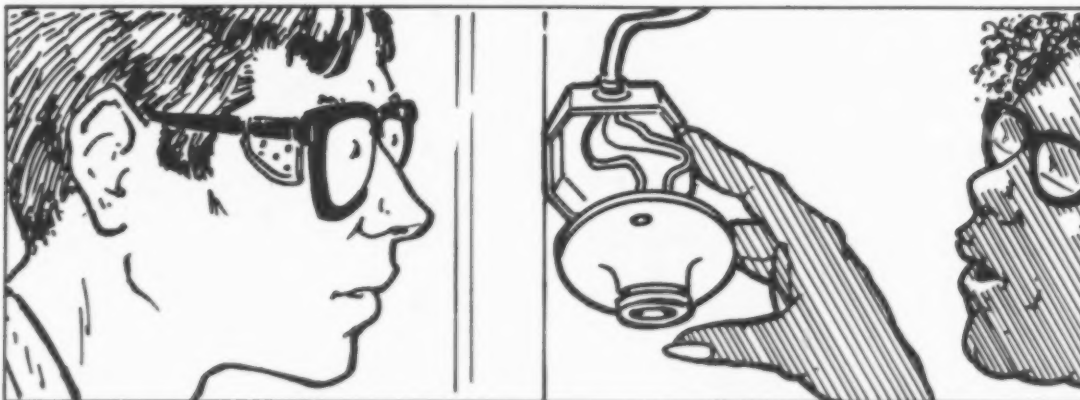


36. Bend the end of the black wire into a loop.

37. Wrap the end around the brass screw. Tighten the screw.

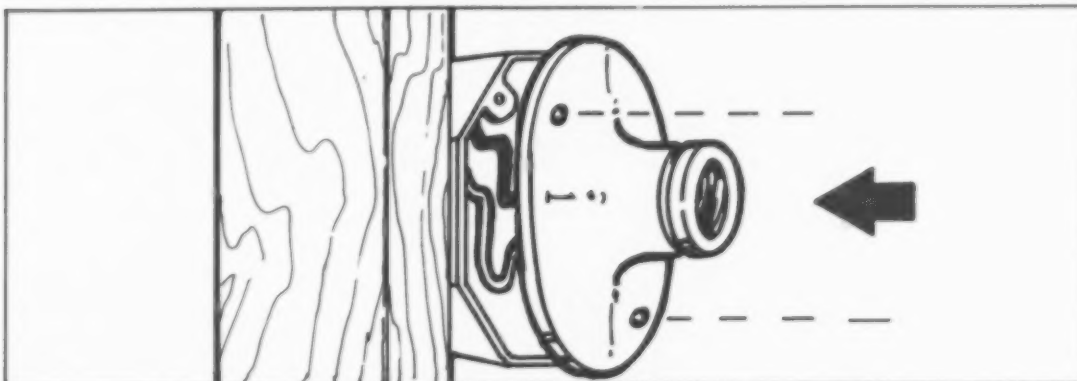


38. Have your teacher check your wiring.



39. Tuck the wires into the boxes.

40. Line up the fixture holes with the holes in the octagon boxes. Fasten the fixtures with the mounting screws.



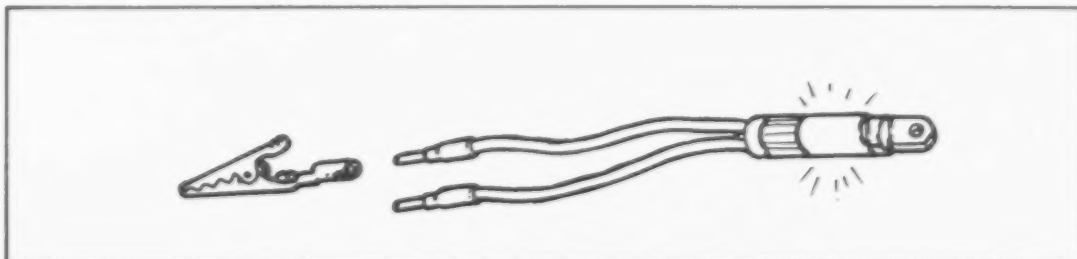
CAUTION

Do not tighten it too much. You can break the fixture.

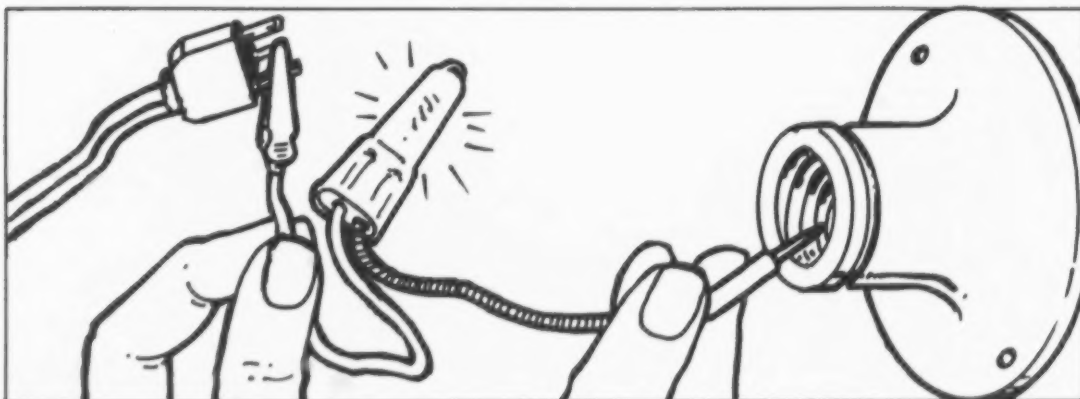
41. Screw in the light bulbs.

42. Ask your teacher to splice the cables in the junction box to a grounded supply cord.

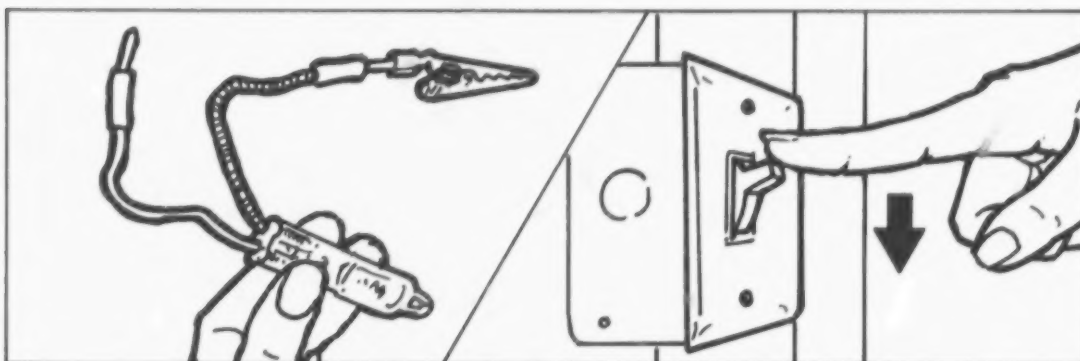
43. Find the continuity tester.



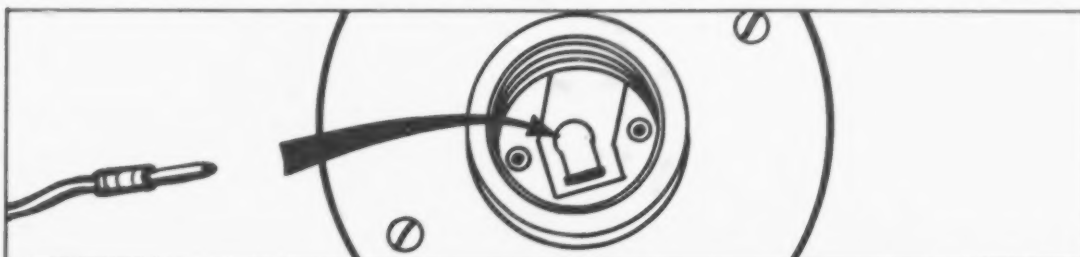
44. Clip the alligator clip to a prong of the plug.
45. Remove the bulb.
46. Touch the metal probe of the tester to the silver lining inside the light fixture.



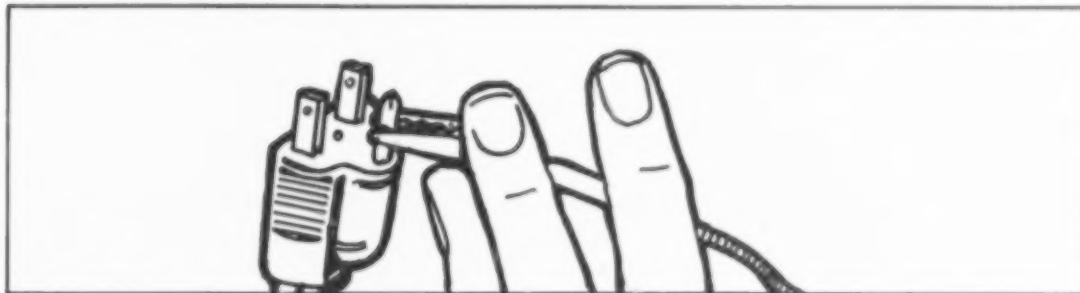
47. If the light in the tester did not go on, clip the alligator clip to the other prong. If the light still does not go on the wires are not connected correctly.
48. Turn the light switch OFF.
49. Take the clip from the tester prong (white wire). Put it on the other prong (black wire).



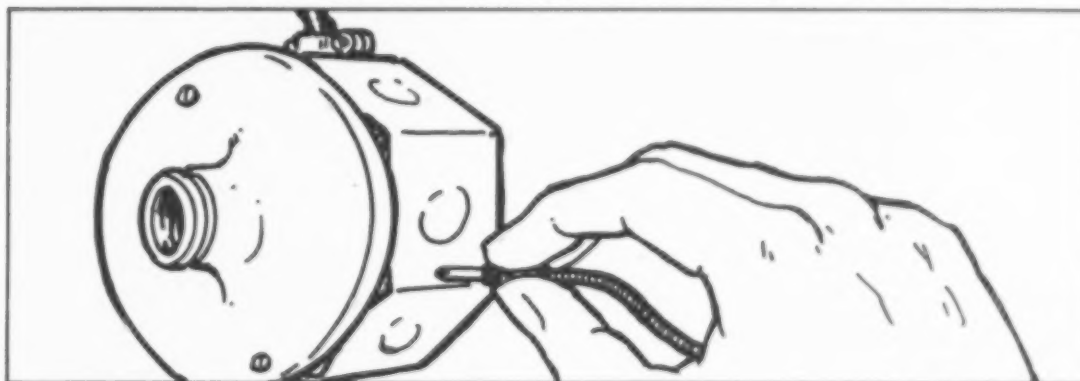
50. Touch the probe tip to the brass piece in the middle of the fixture.



51. The tester light should not go on.
52. Turn the switch on.
53. Touch the probe to the brass piece again. The light should go on.
54. If it does not go on, your black wires are not connected correctly. Check the connections.
55. Move the alligator clip to the ground wire.



56. Touch the probe to the metal octagon box. The light should go on.

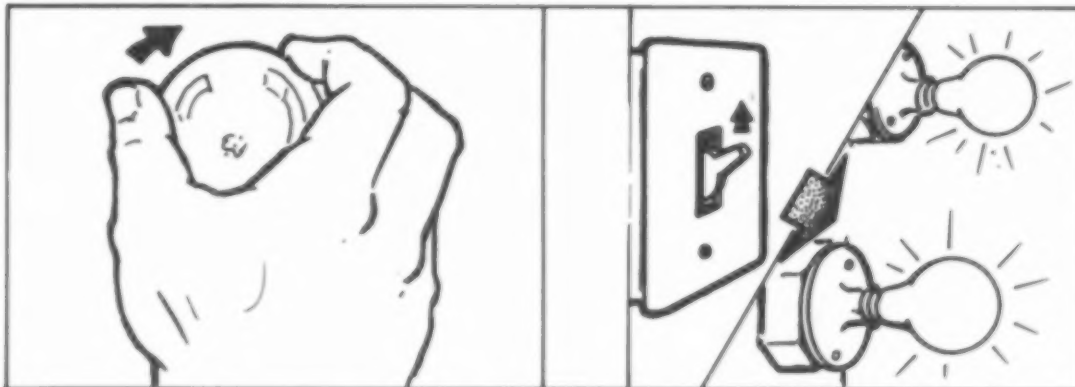


57. Touch the probe to the metal switch box. The light should go on.



58. If the light did not go on when the metal box was touched, the box is not grounded. Grounding helps the box stop shocks. Check your ground wire connections.

59. Replace the light bulbs.
60. If your circuits tested okay with the continuity tester, ask the teacher to connect your work to electricity.
61. After the teacher has connected your work, turn the switch on. The bulbs should light up.



62. Turn the switch OFF. The lights should not glow.
63. If the bulbs did not go on, check the bulbs. If that is not the problem, ask your instructor for help.



64. Clean your work area.
65. Put away tools and materials.
66. See your instructor.

Building Trades - Electrical Construction
Installing Light Fixtures

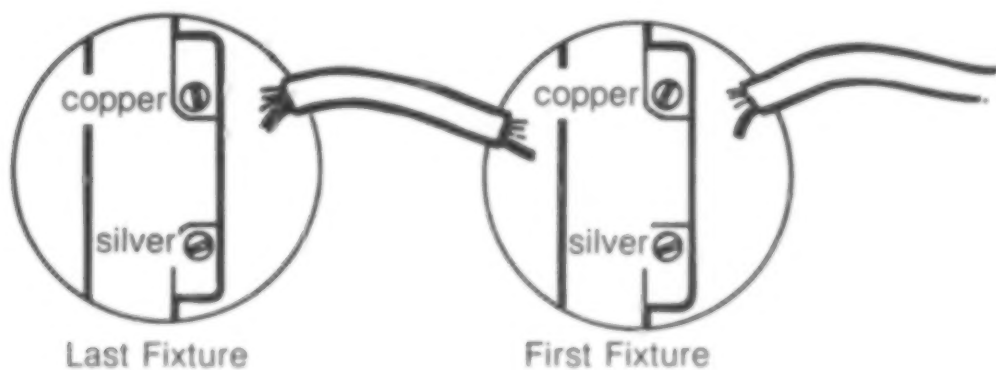
Unit Review

Directions: Circle the letter of the best answer.

1. The most visible part of a wiring system is the:
 - a. switch
 - b. electric light fixture
 - c. octagon box
2. To wire the fixtures you used:
 - a. duplex polarity wiring
 - b. series wiring
 - c. parallel wiring
3. Light fixtures are controlled by a:
 - a. junction box
 - b. switch
 - c. receptacle
4. To prepare the octagon boxes for cable you should:
 - a. clean them with steel wool
 - b. remove the flange
 - c. remove the knockouts
5. Putting cable between the two octagon boxes and through the knockouts is:
 - a. running the cable
 - b. fine finishing work
 - c. parallel wiring
6. To slit the outside cable insulation, use a:
 - a. wire stripper
 - b. side cutting pliers
 - c. cable ripper
7. To fasten the cable to the octagon boxes, use:
 - a. electrical tape
 - b. cable connectors
 - c. solder

8. A pigtail is a:
 - a. tool
 - b. long curled piece of wire
 - c. short piece of wire
9. To check if the current path is broken, use a:
 - a. continuity tester
 - b. light bulb
 - c. pigtail
10. What color of wire should be attached to the brass fixture screw?
 - a. white
 - b. black
 - c. copper (ground)
11. What color of wire attaches to the silver (aluminum) fixture screw?
 - a. white
 - b. black
 - c. copper (ground)
12. To make wire loops, use:
 - a. long nose pliers
 - b. side cutting pliers
 - c. wire strippers
13. To hold wires together, twist them and use:
 - a. masking tape
 - b. a wire nut
 - c. a cable connector
14. The safety device used in electrical work to carry away the excess current is:
 - a. ground wire
 - b. transformer
 - c. parallel circuits
15. To fasten the fixture to the box, use:
 - a. wood screws
 - b. sheet metal screws
 - c. mounting screws

17. Complete the drawing below by drawing lines to show where wires should be connected. Label the color of each wire. Also draw a ☐ to show where each wire nut should be placed.



Building Trades - Electrical Construction
Installing Light Fixtures

Performance Checklist

Student _____ has successfully performed the following steps of procedure.

Installing Light Fixtures	Yes	No	Comments
1. Gathered necessary tools and equipment			
2. Wore safety glasses			
3. Removed knockouts			
4. Mounted box with screws through back of box			
5. Ran cable between the two boxes			
6. Cut and stripped outer insulation			
7. Stripped wire ends			
8. Put on cable connectors and fastened to box correctly			
9. Cut pigtails			
10. Stripped pigtails			
11. Fastened pigtails to fixture and/or box			
12. Connected white wires together in top box			
13. Connected black wires together in top box			
14. Connected ground wires together			
15. Connected ground wire to screw in back of lower box			
16. Connected white wire to silver screw			
17. Connected black wire to brass screw			
18. Had teacher check wiring			
19. Tucked in wire			
20. Fastened fixtures to boxes			
21. Screwed in light bulbs			
22. Had teacher connect the power cord			
23. Tested with a continuity tester			

Installing Light Fixtures	Yes	No	Comments
24. Plugged in power cord			
25. Checked for correct lighting			
26. Unplugged wiring frame			
27. Cleaned area and put away tools			

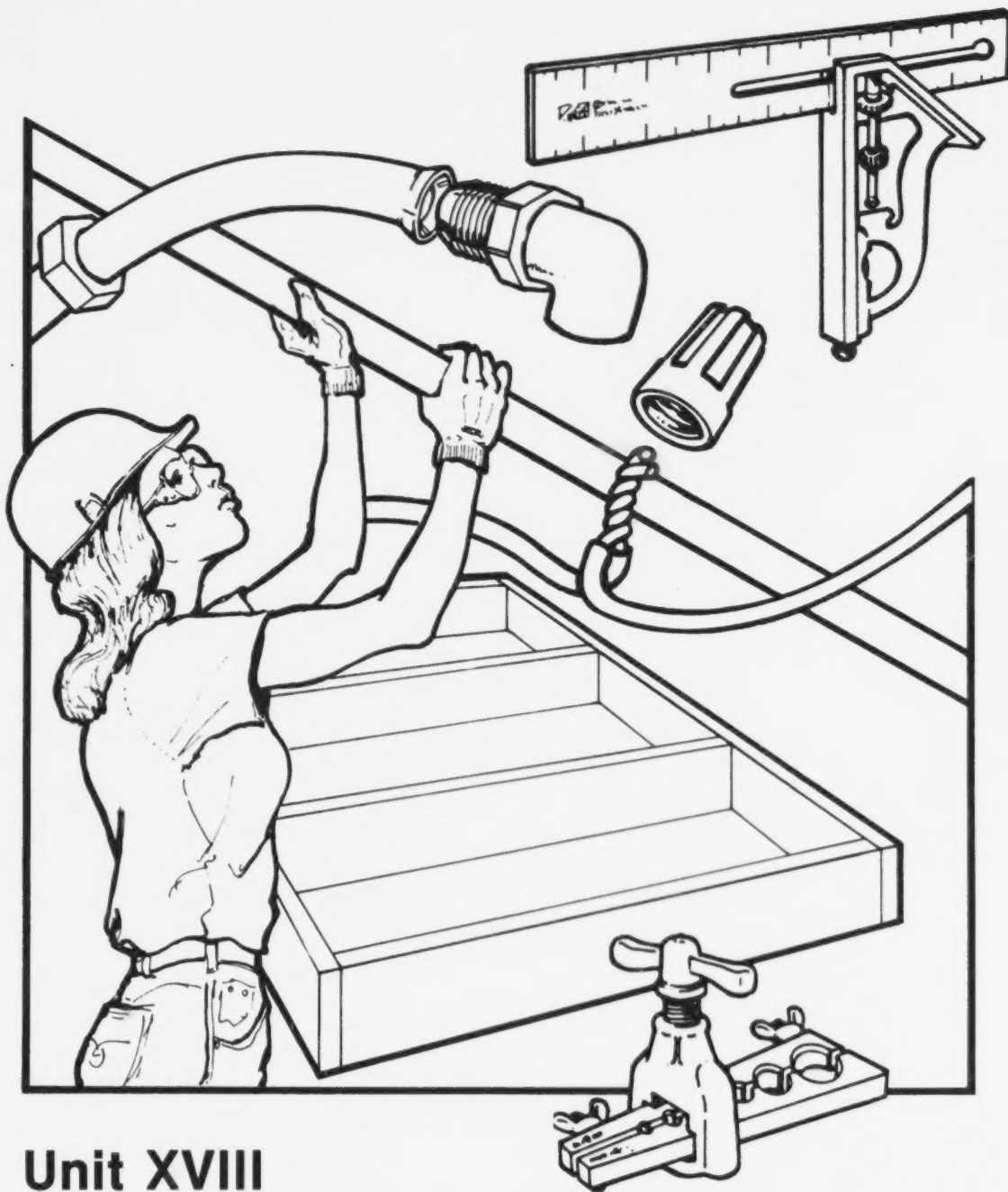
Should Move On ☐

Repeat This Unit ☐

Student's Signature/Date

Instructor's Signature/Date

383



Unit XVIII

Plumbing Materials and Tools

Building Trades - Plumbing

Plumbing Materials and Tools

Plumbing Materials and Tools

After studying this unit, you will be able to:

1. Identify types of pipe.
2. Identify types of fittings.
3. Identify types of fixtures.
4. Identify plumbing tools.
5. Calculate cost of materials for a given plumbing system.

Check the Statement that Fits You Best

☐

I can do these tasks and want to go through the Performance Checklist.



SEE YOUR INSTRUCTOR

☐

I want to study the information in this unit before I do the Performance Checklist.

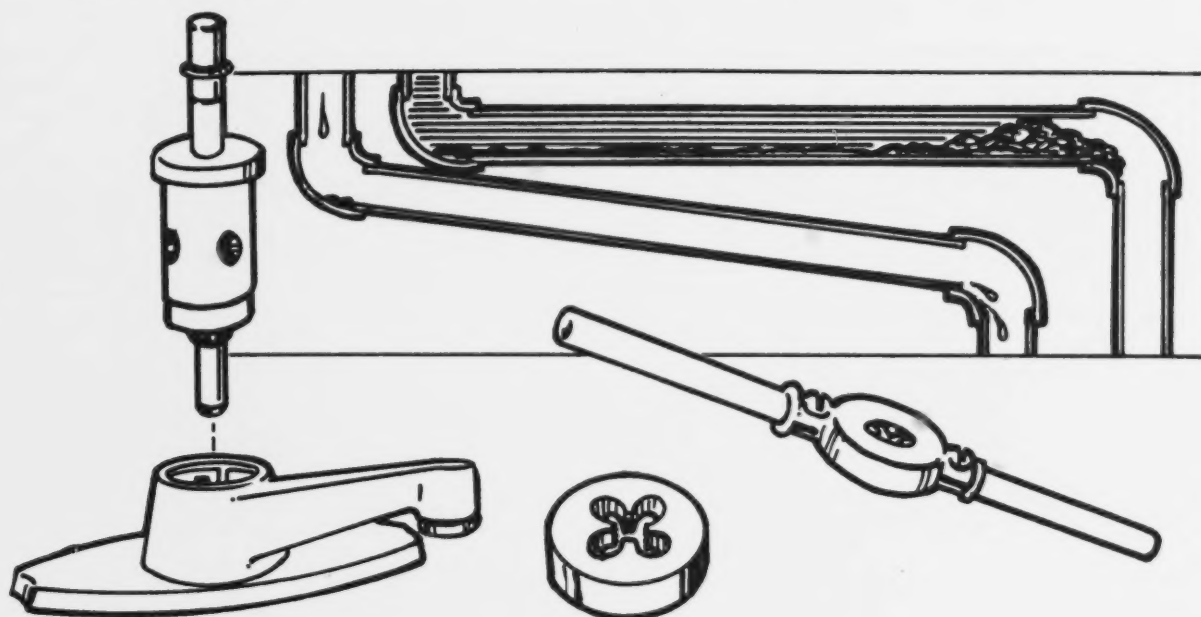


TURN PAGE AND BEGIN

Building Trades - Plumbing
Plumbing Materials and Tools

Introduction

In new home construction, the plumbing system will be installed as the structure is being built. If a structure is built on a slab, the plumbing is usually installed before the concrete is poured. In the frame building, the system is installed in the floor, wall, and ceiling.



To do plumbing installation work, one must be familiar with the tools and materials needed to do a plumbing job. This unit looks at the most common tools and materials you will need and shows you how to calculate costs for plumbing materials.

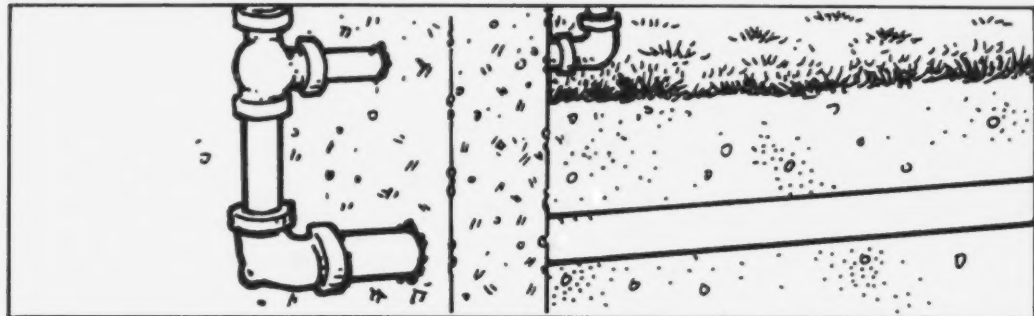
TURN TO NEXT PAGE

Building Trades - Plumbing
Plumbing Materials and Tools

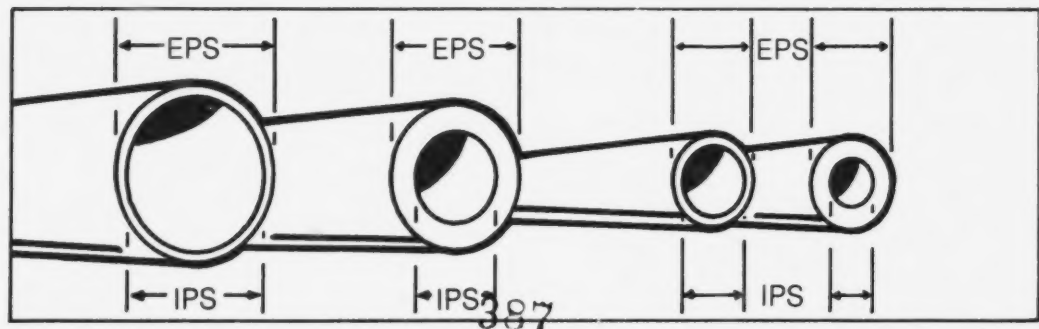
A. Identifying Types of Pipes

Pipe and tubing used in home plumbing are usually one of three most commonly used types; copper, plastic, or iron. Other pipes, such as tile and concrete, may be used but these three are the most common. The type of pipe or tubing and its size to use depends on several factors; what it is used for (water, gas, or sewage), local building codes, and the type of terrain or soil the pipe will be used in.

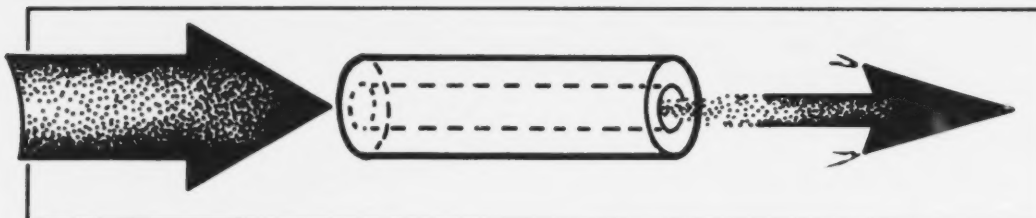
Selection of pipe is determined by its purpose or use. Since pipes are installed in walls, under ground or in hard-to-reach places, the pipe selected should be: strong and durable; resistant to clogging, leaking, and corrosion; and flexible enough to handle extreme temperatures.



Pipes have an inside (IPS) and outside (EPS) diameter measurement. Pipe diameter is measured by nominal size. Nominal size is not an exact size but is near enough to the actual measurement that good seals at the fittings are possible when threading the pipes.



Diameter and length of pipes used must be carefully planned. If a diameter is too small, water or gas pressure will be reduced because of the resistance in the pipeline. If a sewage pipe diameter is too small, the sewage will drain slower and clog much easier.

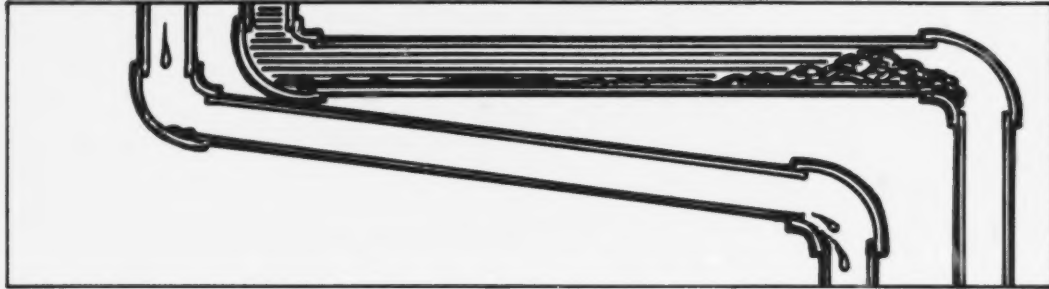


To determine pipe sizes, builders refer to capacity tables and building codes. These tables list requirements for pipes and drainage fall (per foot drop) rates for sewage.

Sample City Building Code

Bath Tubs	1/2 inch pipe
Combination Sink and Tray	1/2 inch pipe
Drinking Fountain	3/8 inch pipe
Dishwasher (domestic)	1/2 inch pipe
Kitchen Sink, residential	1/2 inch pipe
Kitchen Sink, commercial	3/4 inch pipe
Lavatory	3/8 inch pipe
Laundry Tray, 1, 2, or 3 compartment	1/2 inch pipe
Shower (single head)	1/2 inch pipe
Sinks (service, slop)	1/2 inch pipe
Sinks (flushing rim)	3/4 inch pipe
Urinal (flush tank)	1/2 inch pipe
Urinal (direct flush)	3/4 inch pipe
Water Closet (tank type)	3/8 inch pipe
Water Closet (flush valve)	1 inch pipe
Hose Bibs	1/2 inch pipe
Wall Hydrant	1/2 inch pipe
Water Heater	3/4 inch pipe

Gravity and pressure also affect a plumbing system. Sewage is carried away by gravity. That is why it is important that the sewage system pipes have an adequate per foot drop when you install them. Sharp turns or little drop per foot will cause pipes to clog even if they are the correct size.

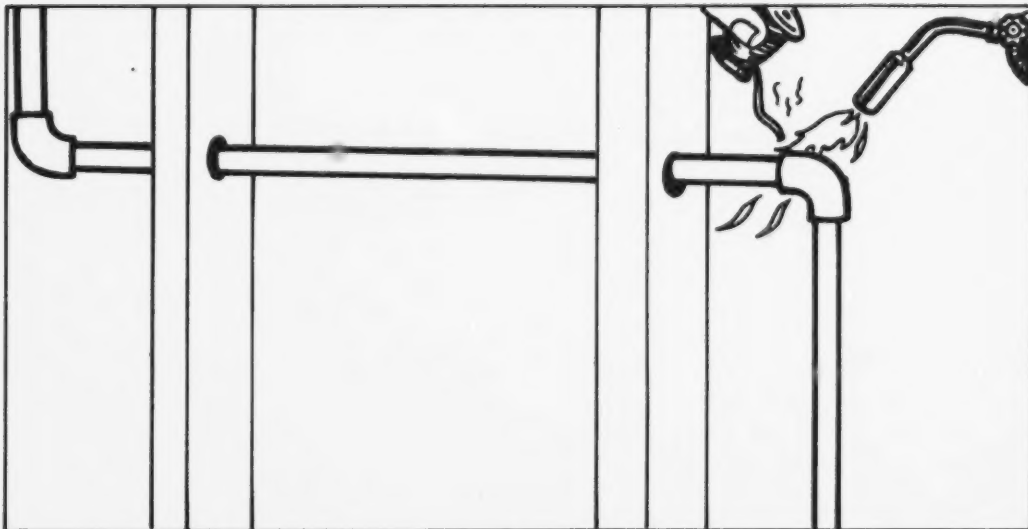


Fresh water (and gas) is forced through the system by pressure (a water tower creates pressure) but the system still needs gravity for venting and draining.

Types of Pipe and Tubing

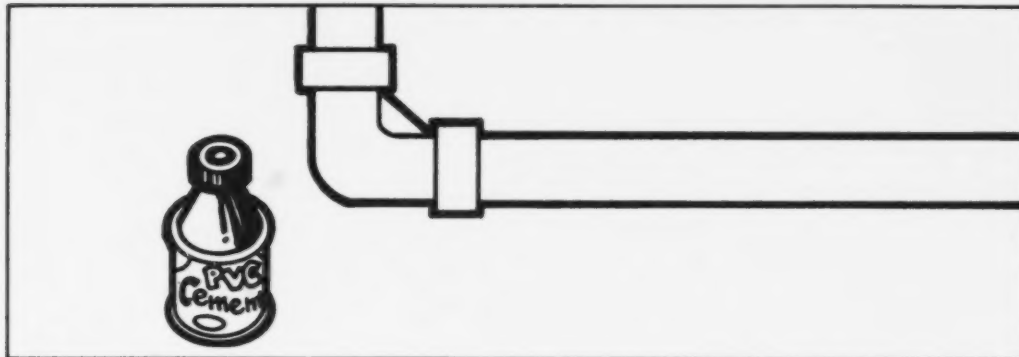
Copper-

is used in hot and cold water systems. Thickness of its walls determines its use within the hot/cold system. Copper tubing must be sweat soldered or flared and screwed with copper fittings. It is more expensive but long-lasting. Its small size allows it to be put into narrow, tight places like walls.



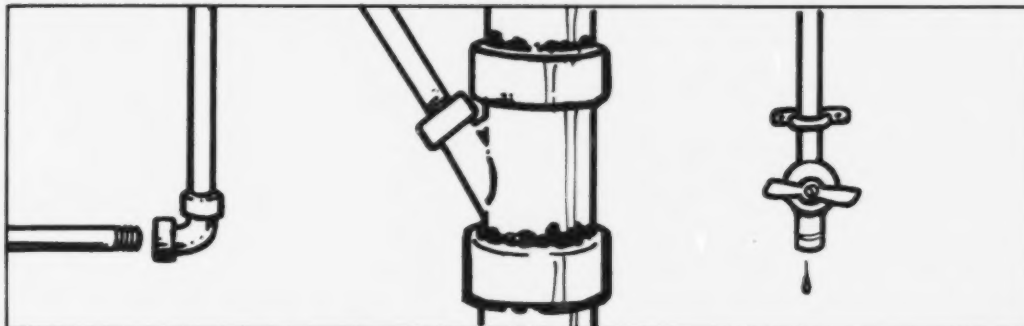
Plastic-

most frequently used type of plastic is CPVC. It is not as strong as the metal types and more sensitive to hot and cold temperatures. Plastic pipe is lightweight and easy to install. Fittings are usually sealed with a plastic cement.



Iron-

used where large diameter pipes are needed, mostly outside of a structure for water mains or sewage drains. Strong and long-lasting, iron is sealed with an asphalt-type substance and melted lead or it can be bolted together.



Building Trades - Plumbing
Plumbing Materials and Tools

B. Identify Types of Pipe Fittings

Pipes and tubing do not come in one continuous piece and must be fitted together without leaking. To insure a proper and permanent seal between pipe sections, the fittings used must be made of the same material. This way, the bonding agent will adhere well to both surfaces and create a good seal.

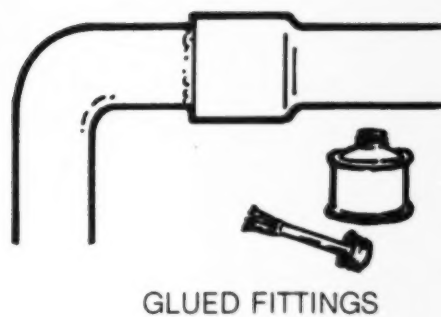
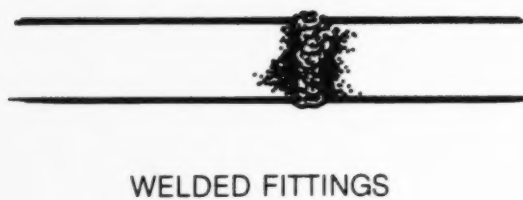
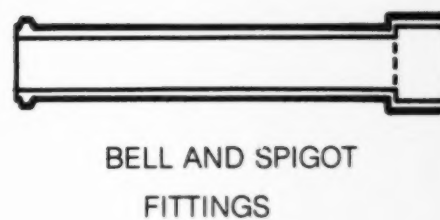
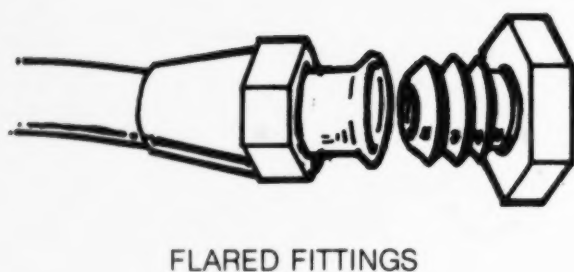
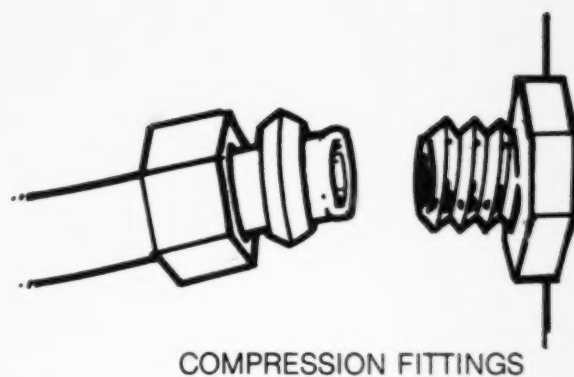
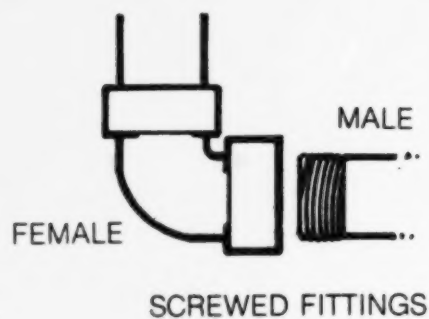
Regardless of what material they are made of, their names and uses are the same. Fittings are standardized by diameter, and threads per inch like the pipes or tubing are.

There are hundreds of fittings for plumbing, many are specialized, many are very common. Some of the most commonly used fittings are:



A plug or cap is used to stop the flow in a pipe.

How Fittings are Secured

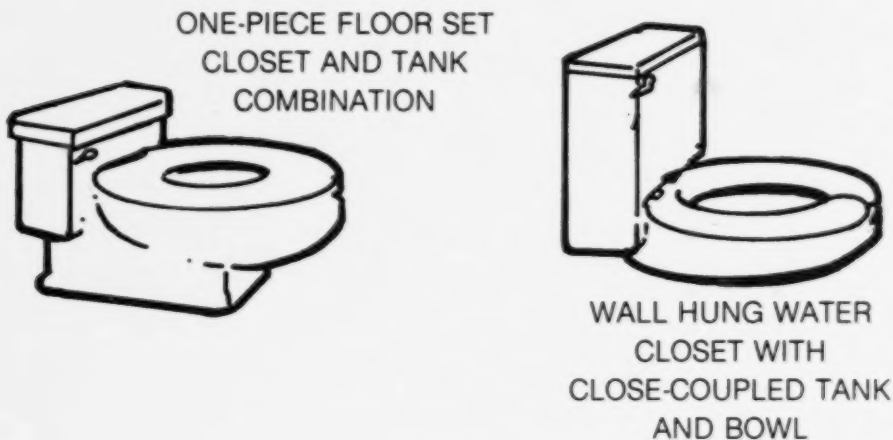


Building Trades - Plumbing
Plumbing Materials and Tools

C. Identify Types of Plumbing Fixtures

Plumbing fixtures are the containers into which wastes are put as they are released into the sewage system. Fixtures can be made of enamel coated cast-iron, vitreous china, stainless steel, and plastic. These fixtures must be handled carefully to avoid breaking, scratching, or damaging in any way.

Fixtures, like other plumbing materials and supplies, are many and varied. The following show the most commonly used fixtures in a household plumbing system.



The Water Closet and Closet Tank Fixtures

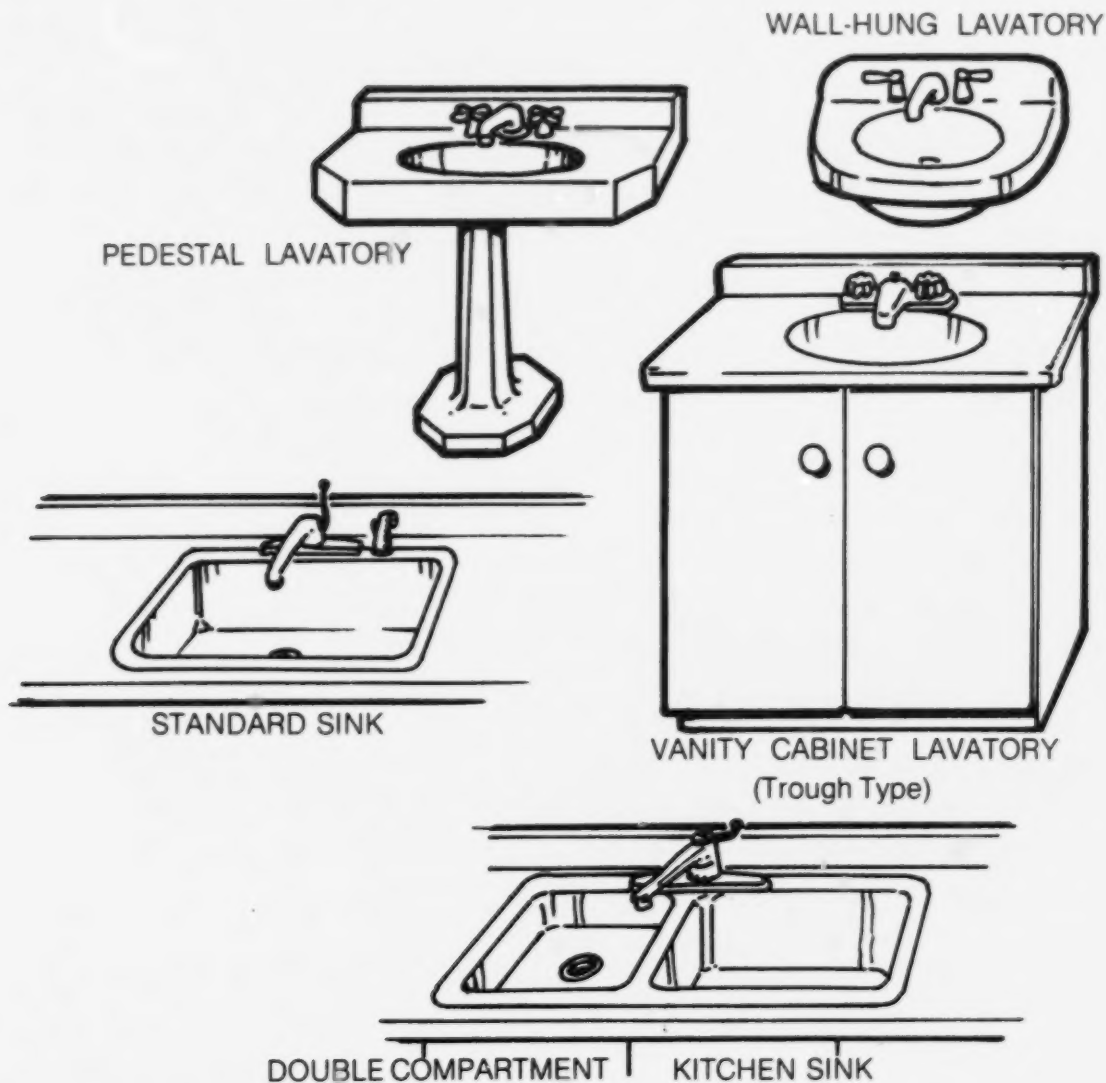
This fixture disposes of human wastes. You probably know it as a stool. The water closet is the bowl part. The closet tank holds the supply of water to flush out the water closet.

Water closets range from an inexpensive, simple to operate system, to the more complicated, expensive systems. Regardless of how it operates or how much it costs, they are all installed in the same manner.

Lavatory/Sink Fixtures

Lavatories and sinks can be made of vitreous china, cast iron and enamel, stainless steel, or plastic. They come in all shapes, colors, and sizes.

The lavatory and sink is supplied with hot and cold water and drains directly into the sanitary sewer system. A vent and a trap are needed to prevent odor and gas build-up. Sinks can have a double sink construction for more efficiency. The most common types of lavatories and sinks are:

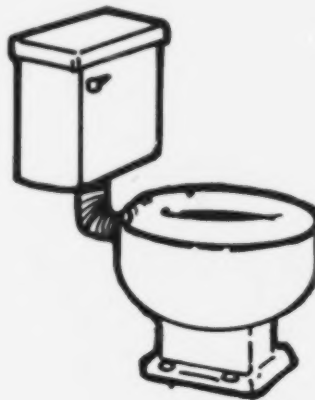


The water tank is used mostly on residential water closets where a minimal number of flushes occur. Most maintenance will need to be done to the operating parts in the tank. The water tank is supplied with cold water only and empties directly into the sanitary sewer system.

The water closet and water tank are both usually made of vitreous china so extreme care must be taken when working with them.



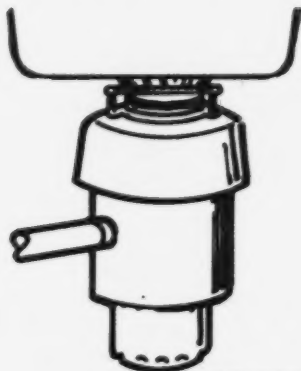
FLOOR SET CLOSET
WITH CLOSE-COUPLED
TANK AND BOWL



FLOOR SET CLOSET
WITH WALL HUNG TANK

Other Fixtures

In plumbing construction, you will often have to put in other plumbing fixtures as well as the basic ones you have just seen. Most, depending upon the manufacturer, will have specific instructions for that model. These additional fixtures include:



GARBAGE DISPOSAL

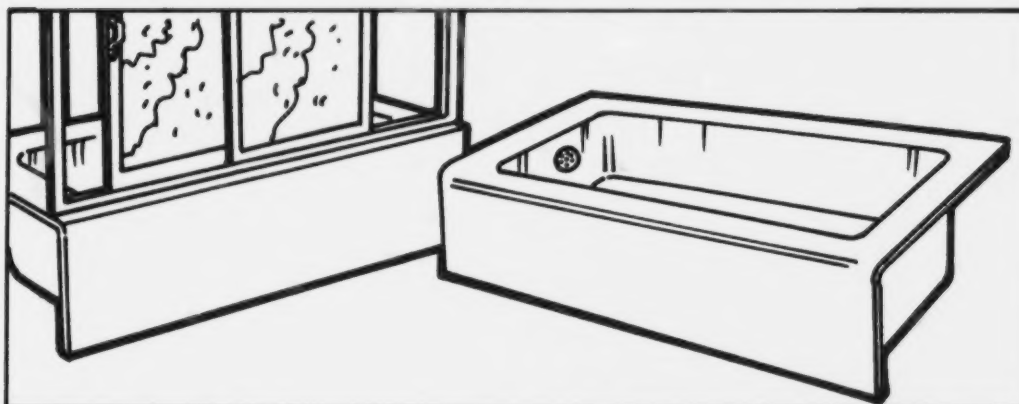


DISHWASHER

Bathtub/Shower Fixtures

Bathtubs are made from enamel coated metal, fiberglass, and plastic in a variety of shapes and colors. Bathtubs can have a right-hand or left-hand construction, depending upon where the drain must be placed.

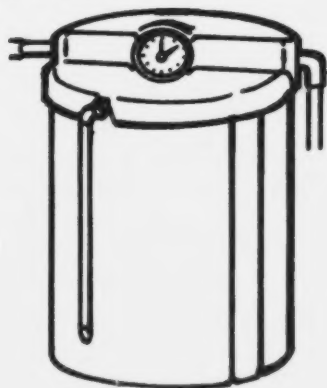
The two most common modern bathtub designs are the recessed bathtub and the bath-shower module. Some older types and specialty designs have legs to raise them off of the floor.



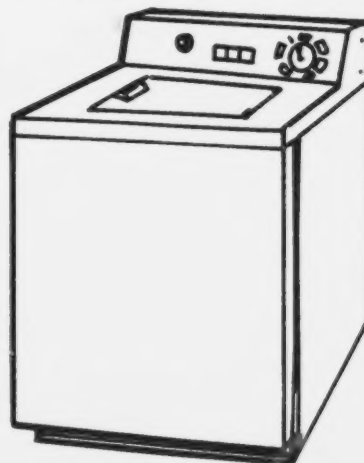
The recessed bathtub is permanently attached to the walls and floor. The bath-shower module is also permanently attached and comes as a one or two piece unit. It is usually made of fiberglass or plastic.

A shower-only fixture has advantages over a bathtub. The three most obvious advantages are the smaller amount of space to install it, less amount of water used, and ease of cleaning. The two most common types of showers are the tiled shower and the one piece prefabricated unit. These fixtures are all supplied with hot and cold water and drain through the floor. Plumbing installation work will be generally the same for each. Work should be done carefully and correctly because most of the plumbing work will be sealed in the wall and under or behind the fixture.

WATER SOFTENER



WASHING MACHINE



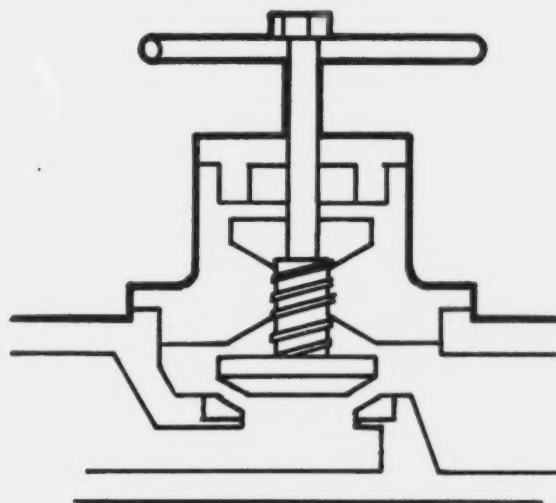
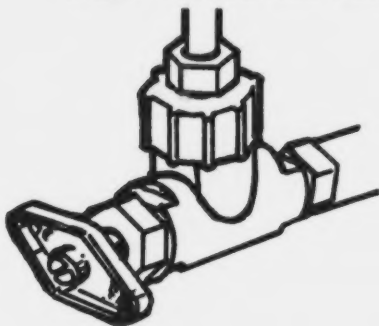
WATER HEATER



Valves and Faucets

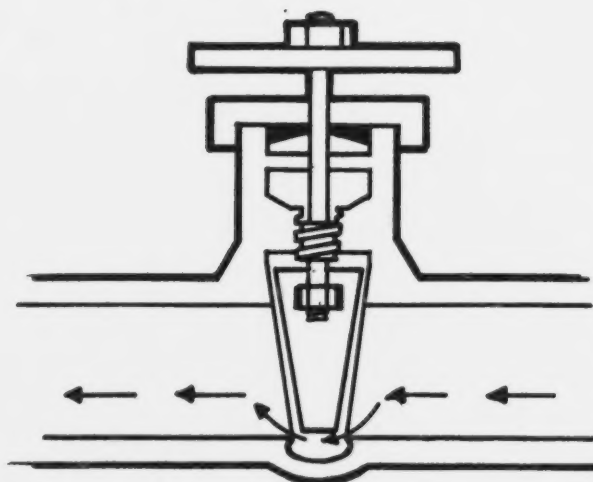
Valves-

There are three main types of valves used in a water supply system of a house; the globe, gate, and check valves. Each of these valves has variations, but the principle is the same.



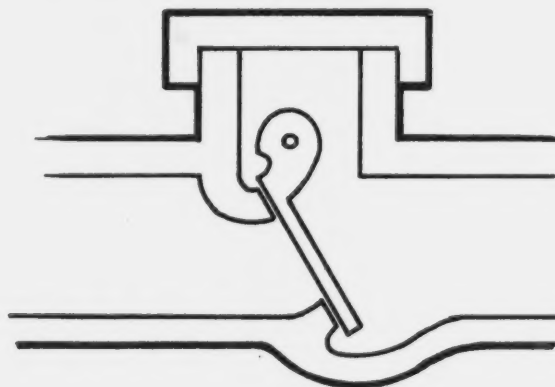
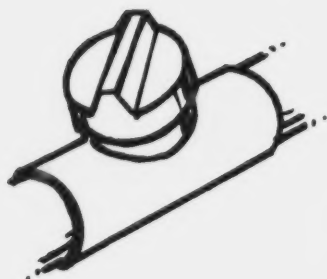
The globe valve-

is used to shut off water to fixtures and appliances. The globe valve is strong enough to shut off relatively high pressure (because the water must make two 90° turns).



The gate valve-

must be all the way open or all the way closed. If not completely closed it can wear itself out (by vibration) and not stop the flow of water as it should. In some gate valves, the stem rises with the gate, in other models, the gate rises but the stem does not.

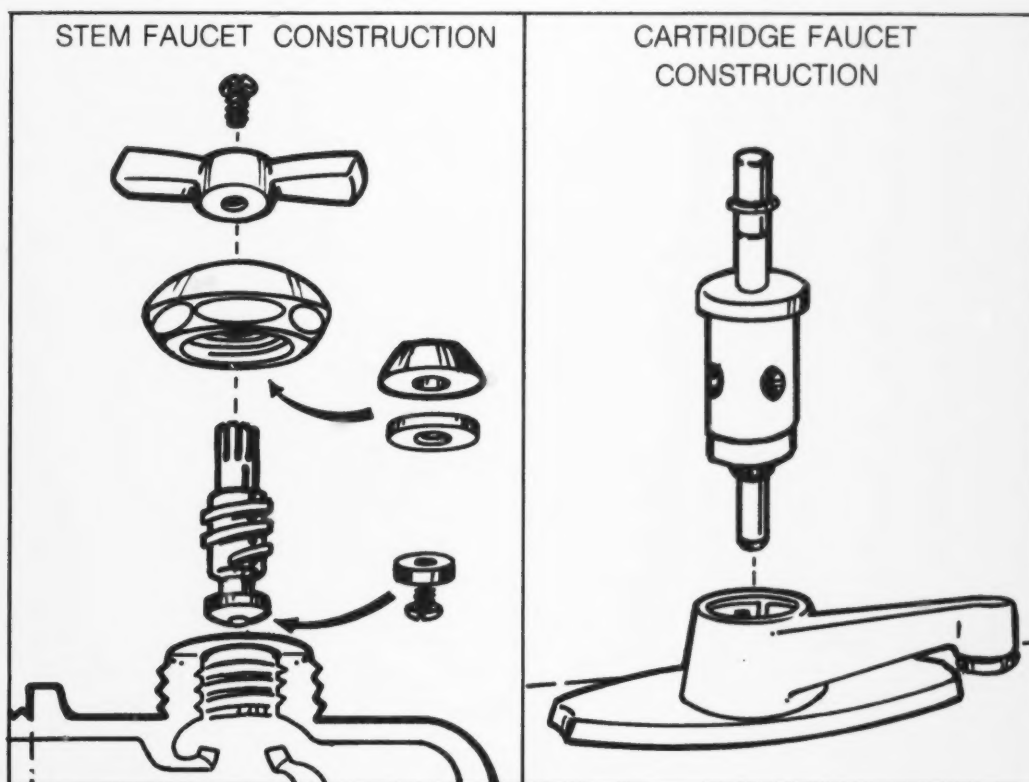


The check valve-

is designed to allow water to drain in only one direction. If water tries draining back the way it came, the pressure closes the valve flap and prevents a backflow. Check valves should be installed so that the flap lifts upwards. This allows gravity to keep the flap closed.

Faucets

Regardless of the type of faucet, they are all designed to do one thing - control the flow of water. The two most common faucet types are the stem faucet and the cartridge-type (washerless) faucet.



In a stem faucet, a stem with a hard rubber disk or washer is fitted into the body of the faucet and is raised and lowered onto the seat by a screw thread. Leaks occur when the washer is worn or ragged and does not seal. Replacing this washer usually fixes the leak.

In a cartridge-type faucet, a cartridge takes the place of the stem. The cartridge presses against a separate washer and spring in the faucet body. Adjusting the lever allows hot and cold water to be mixed and to flow. The cartridge is replaced when repair work is necessary.

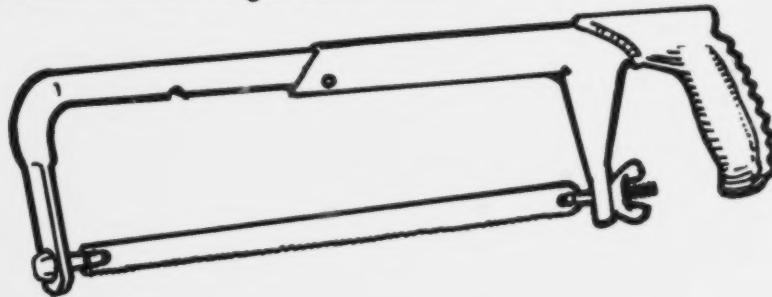
Building Trades - Plumbing

Plumbing Materials and Tools

D. Identify Plumbing Tools

Plumbing work cannot be done without the proper tools. The following are some of the more commonly used plumbing tools and their uses. You will find that you need even more specialty tools for certain tasks but these will allow you to do most basic plumbing jobs.

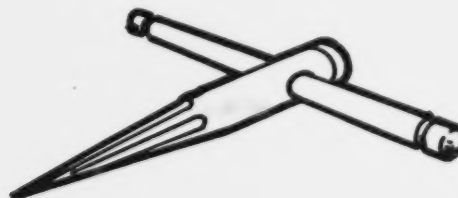
1. Hacksaw - one of the plumber's most important tools, it is used to cut templates and small tubing. Eighteen teeth per inch is the recommended blade for general use.



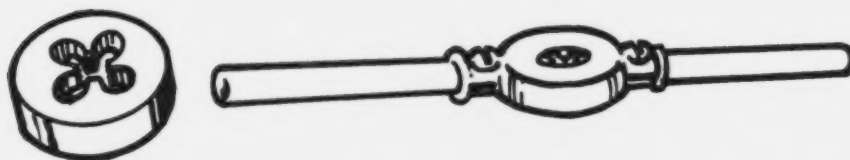
2. Pipe Cutter - a cutter with two rollers and a cutting edge to cut pipe and tubing to desired length



3. Pipe Reamer - used to remove burrs by rotating the inside of a pipe. Pipe reamers come in various sizes to fit different sized pipe and tubing.



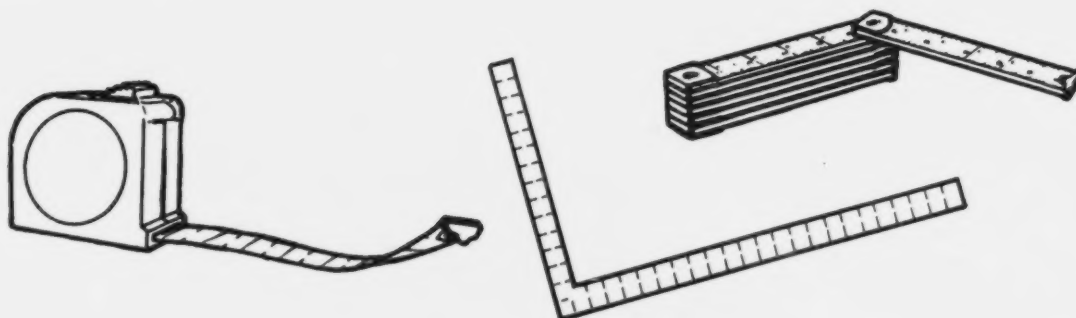
4. Pipe Die - used to cut threads on the outside diameter of a pipe



5. Pipe Tap - used to cut threads on the inside diameter of a pipe



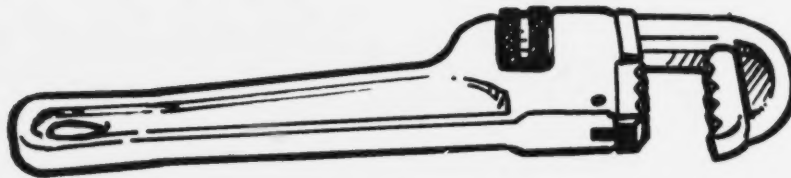
6. Measuring Tools - used to measure specific lengths for plumbing accuracy



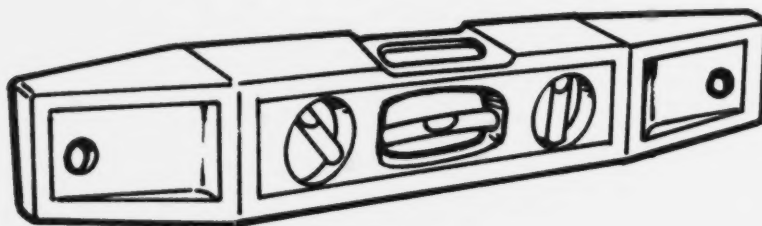
7. Cutting Lubricant - oil used when cutting to reduce friction and wear



8. Pipe Wrench - adjustable tool with teeth to grip and hold a pipe. Pipe wrenches should be sized to the pipe.



9. Torpedo Level - used for grading pipe and plotting the per foot drop to allow for proper drainage. Also used to check levelness when installing fixtures, etc.



10. Cleaning Tools - used to clean copper tubing and fittings for sweat soldering

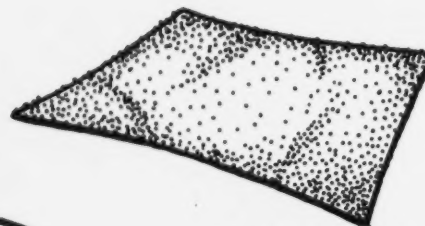
STEEL WOOL



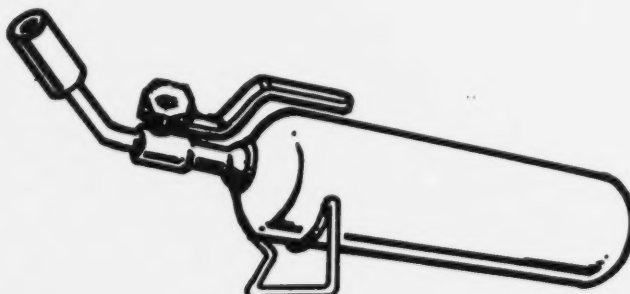
BRUSH



EMERY CLOTH



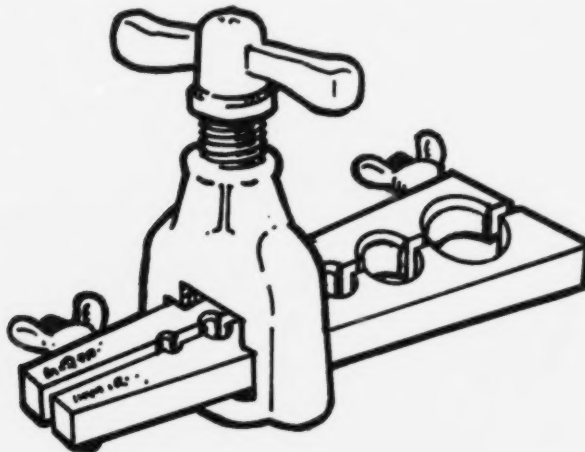
11. Propane Fuel - most common method of heating copper pipes for sweat soldering



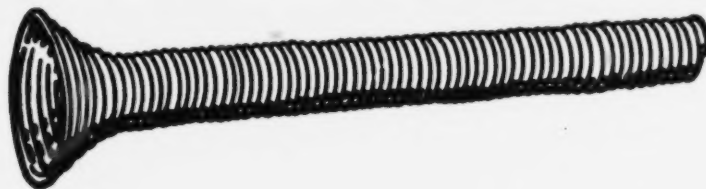
12. Hammer-Type Flaring Tool - used to make a flared (expanded) end on copper joints. Each size of tubing requires a matching size of hammer-type flaring tool.



13. Yoke and Screw Flaring Tool - flares several different sizes of copper tubing. Tubing is flared by screwing the yoke into the pipe end.



14. Bending Tool - type of tool used to bend copper tubing to fit certain angles or places. Cannot be used on all tubing.



Building Trades - Plumbing
Plumbing Materials and Tools

E. Calculate the Cost of Materials for a Given Plumbing System

Your first plumber's apprentice job is to estimate the cost of adding a sink to a room by tapping into an existing system. The plumber has made a list of materials and fixtures necessary to complete the job.

Your task is to add these costs for materials and fixtures, and the labor cost for you and the plumber.

Listed beside each item below is its cost (including tax) from the local plumbing supply store. Add these figures for your materials and fixtures cost and put that total in the space provided.

For labor costs, you make \$14.00 per hour and the plumber makes \$32.00 per hour. Add the cost for the two of you for 5 hours labor each. Put that total in the space provided.

MATERIALS AND FIXTURES

Sink Assembly

- Pedestal Sink.....\$35.50
- Hot/Cold Faucet.....\$25.99
- Trap.....\$6.39
- Chrome Supply Lines -
2 at \$2.50
- Chrome Shut-off Valves -
2 at \$3.75

Supply Line (Copper Tubing)

- 1/2" Rigid (M) Tubing -
40 Ft.....50¢ per foot
- 90° Fitting.....2 at .18¢
- Coupling.....4 at .21¢
- Caps.....2 at .18¢
- T-Fittings.....4 at .32¢

Drain Line (ABS Pipe)

- ABS Pipe -
28 Ft.....46¢ per foot
- Couplings.....2 at .44¢
- 45° Fittings.....2 at \$1.99
- T-Fitting.....\$1.99
- Y-Branch Fitting.....\$3.25
- Tap Adapter.....\$1.10
- Stack Flashing.....\$3.60

Miscellaneous

- Solder (1 lb.).....\$2.40
- Flux......79¢
- Propane.....\$2.20
- Plumber's Straps.....6 at \$2.70
- Other (sandpaper, putty, drain cap,
glue, etc.).....\$8.00

SHOW YOUR WORK ON THE BACK

TOTAL MATERIALS
AND SUPPLIES COST

LABOR COST FOR
YOU

LABOR COST FOR
PLUMBER

TOTAL LABOR COST

TOTAL COST FOR MATERIALS, SUPPLIES, AND LABOR \$ _____

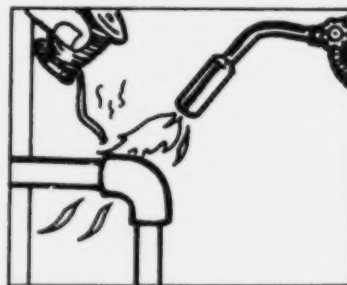
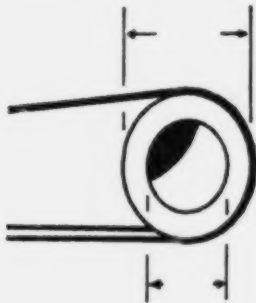
Building Trades - Plumbing
Plumbing Materials and Tools

Unit Review

Directions: Identify the following pieces by putting the correct name in the blank space. Choose from these words:

T-FITTING TRAP Y-BRANCH IPS EPS REDUCER ELBOW PLUG
 COUPLING COPPER PIPE PLASTIC PIPE

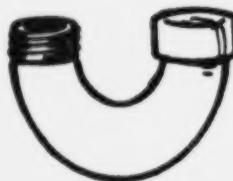
1. _____



3. _____



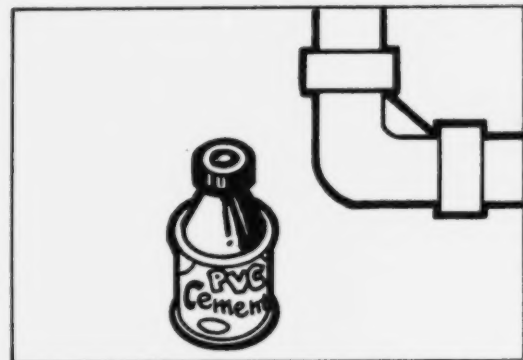
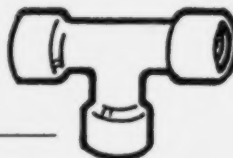
2. _____



4. _____

5. _____

6. _____



7. _____

9. _____



8. _____



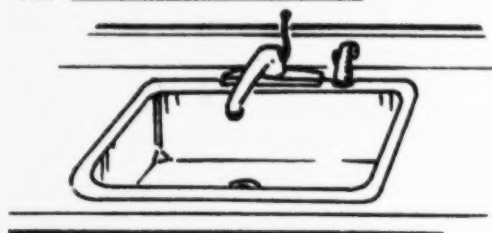
10. _____

11. ~~405~~ _____

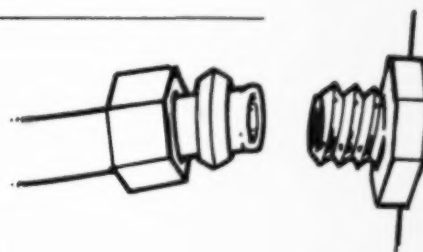
Directions: Match the name with its correct illustration. Choose from the following words:

FLARED FITTING SINK LAVATORY COMPRESSION FITTING WATER CLOSET

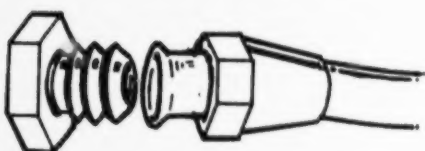
12. _____



13. _____



14. _____



15. _____



16. _____

Directions: Match the correct word with its definition.

_____ 17. Globe Valve

_____ 18. Gate Valve

_____ 19. Check Valve

_____ 20. Cartridge Faucet

_____ 21. Stem Faucet

A. Valve must be completely opened or completely closed

B. Valve used to shut-off high water pressure

C. Valve which allows water to run in one direction only by preventing a backflow

D. Faucet with a stem and washer to control flow and mix of water

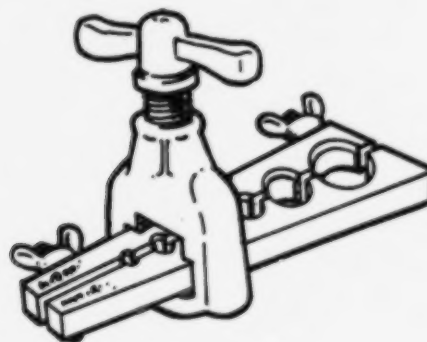
E. A cartridge in this faucet controls the flow and mix of water

Directions: Match the illustration with its correct name by writing the name in the correct blank.

PIPE DIE PIPE TAP FLARING TOOL

29. _____

28. _____



30. _____

Building Trades - Plumbing
Plumbing Materials and Tools

Performance Checklist

Student _____ has successfully performed the following steps of procedure.

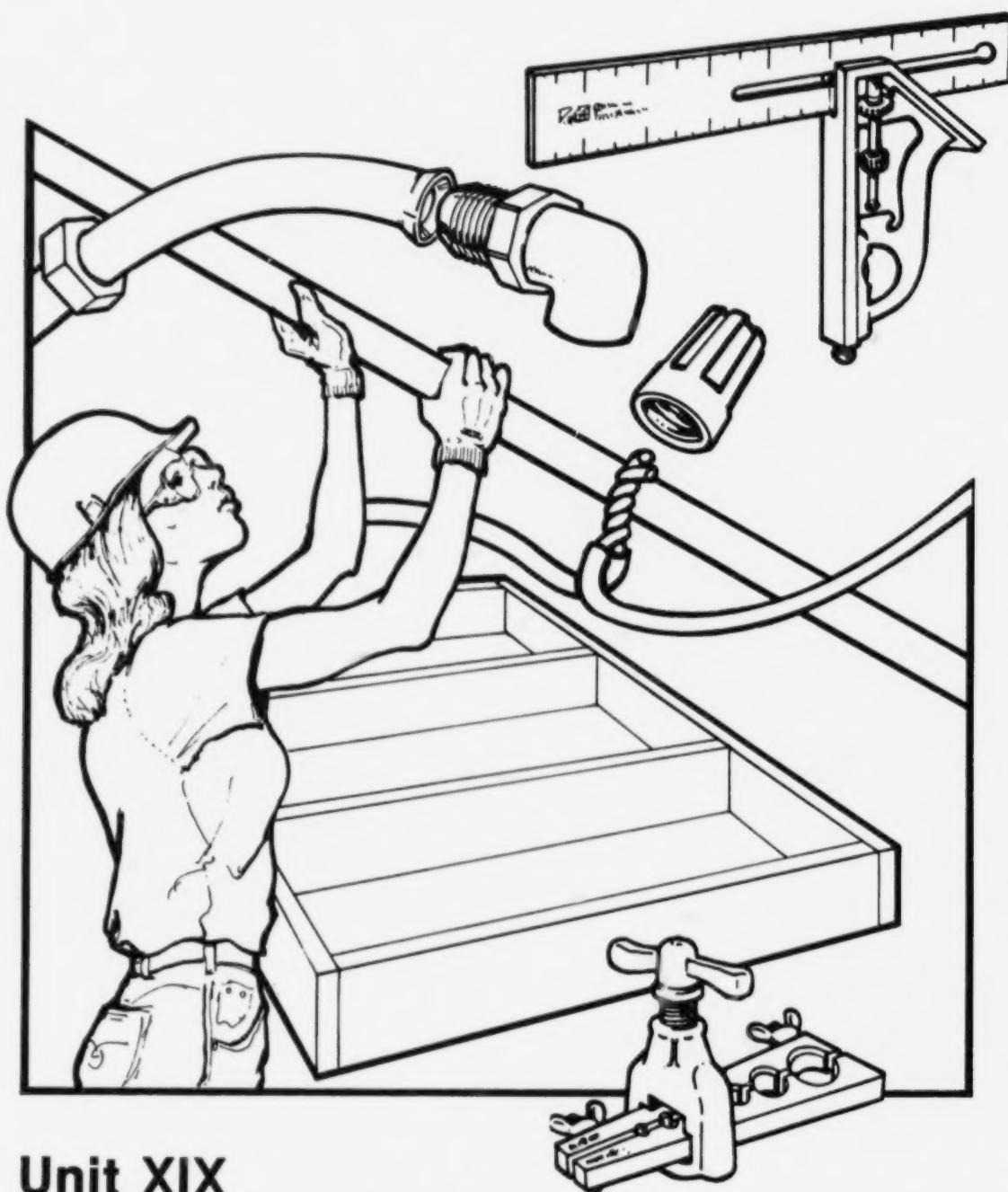
Plumbing Materials and Tools	Yes	No	Comments
1. Identified copper tubing			
2. Identified plastic tubing			
3. Identified cast iron pipe			
4. Identified different types of pipe fittings			
5. Identified ways fittings are secured			
6. Identified globe valve			
7. Identified gate valve			
8. Identified check valve			
9. Identified stem valve			
10. Identified cartridge faucet			
11. Identified common plumbing tools			
12. Correctly calculated materials cost for a plumbing job			

Should Move On ☐

Repeat This Unit ☐

Student Signature/Date

Instructor Signature/Date



Unit XIX

Working with Plastic Pipe

Building Trades - Plumbing

Working with Plastic Pipe

Working with Plastic Pipe

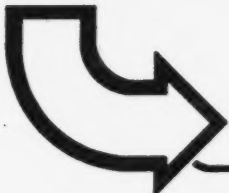
After studying this unit, you will be able to:

1. Measure plastic pipe, including allowance for fittings.
2. Cut plastic pipe from these measurements.
3. Glue joints in plastic pipe.

Check the Statement that Fits You Best

☐

I can do these tasks and want to go through the Performance Checklist.



SEE YOUR INSTRUCTOR

☐

I want to study the information in this unit before I do the Performance Checklist.



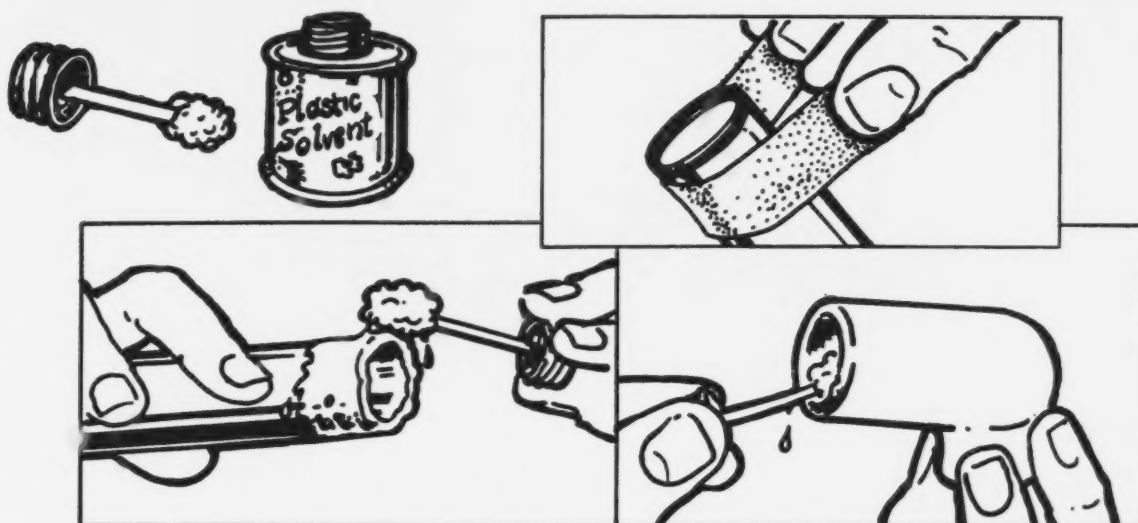
TURN PAGE AND BEGIN

Building Trades - Plumbing

Working with Plastic Pipe

Introduction

Plastic pipe is easy to work with, requires few tools and no solder or flame, and is now being used by homeowners and by professionals in new installations. It will last for a hundred years, and is non-corrosive and forms less deposits.



The types of plastic pipe are polyvinyl chloride (PVC), chlorinated polyvinyl chloride (CPVC), polybutylene (PB), and acrylonitrile-butadiene-styrene (ABS). ABS is used for drain, waste and vent systems. PB cannot be solvent welded and is joined with compression fittings. PB and CPVC come in the same standard sizes as copper tubing and can be flared to accept flare fittings. Existing steel and copper tubing can be replaced by plastic tubing with the appropriate conversion fittings.

Plastic pipe, especially PB pipe which is extremely flexible, requires less accuracy in cutting to length than do steel or copper pipe.

Building Trades - Plumbing

Working with Plastic Pipe

A. Tools and Equipment

1. Emery Cloth - Abrasive grit on flexible cloth-backed strip used to clean the ends of copper pipe before soldering.
2. Pipe Solvent - Cement used to join plastic fittings to plastic pipe.
3. Cleaning Solvent - Solvent used sometimes before the pipe solvent to prepare the surface of the plastic to accept the solvent.
4. Plastic Tubing Cutter - Tubing cutter with a special blade for cutting plastic pipe.

Building Trades - Plumbing
Working with Plastic Pipe

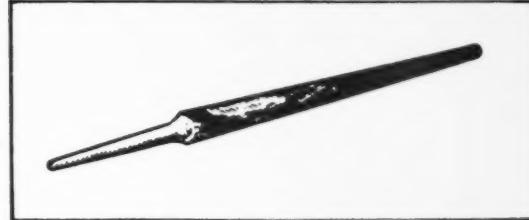
B. Cutting and Joining Plastic Pipe

1. Assemble tools and materials needed to cut and join plastic pipe.

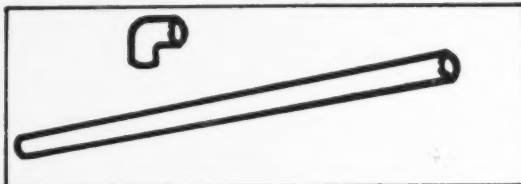
Plastic Tubing Cutter



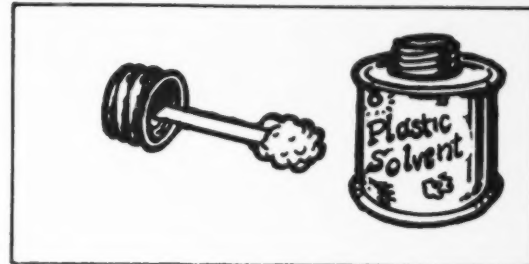
Round File



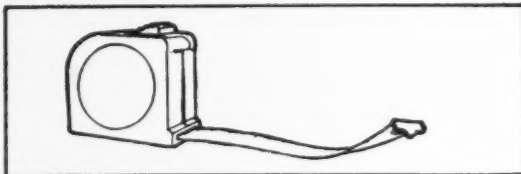
Plastic Pipe and Connector



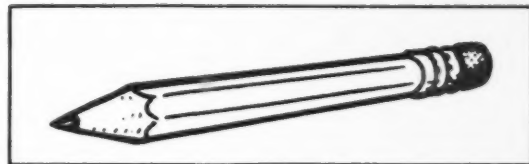
Plastic Solvent



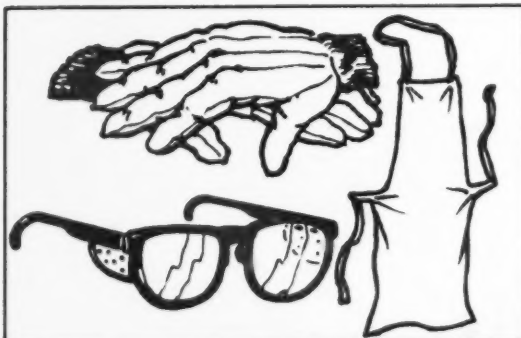
Tape Measure



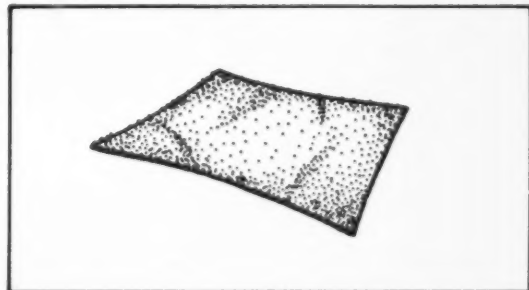
Pencil



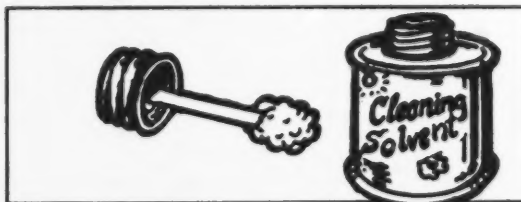
Safety Equipment



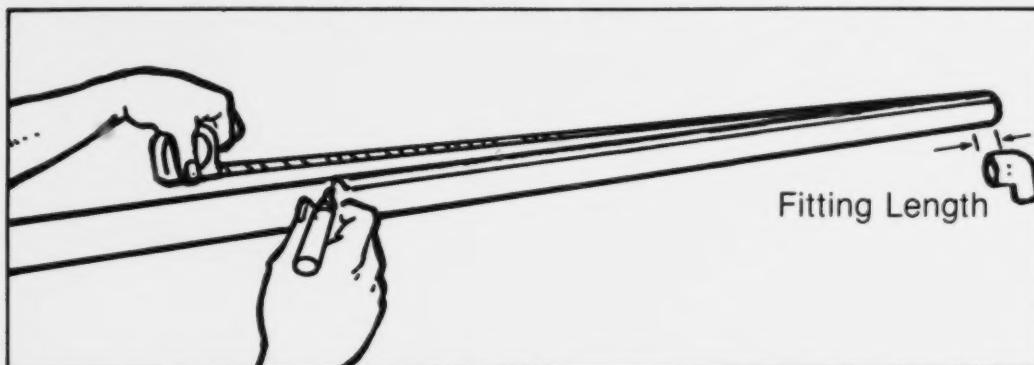
Emery Cloth



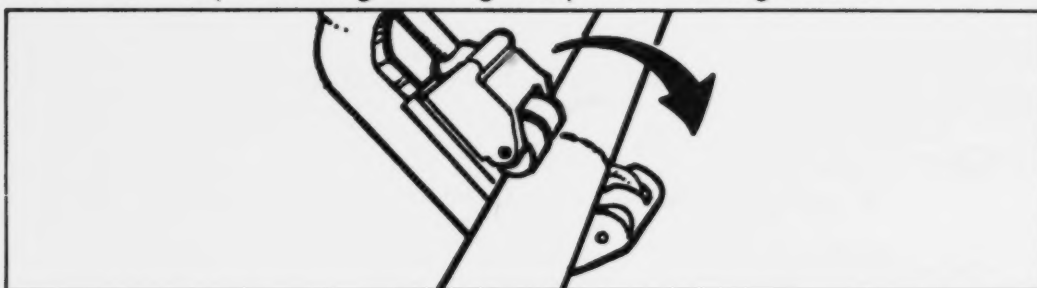
Cleaning Solvent



2. Put on safety equipment.
3. Measure the length of plastic pipe needed and mark the pipe with a pencil or magic marker. Be sure your measurement allows enough length to fit inside the pipe fittings at both ends.



4. Cut to the required length using the plastic tubing cutter.



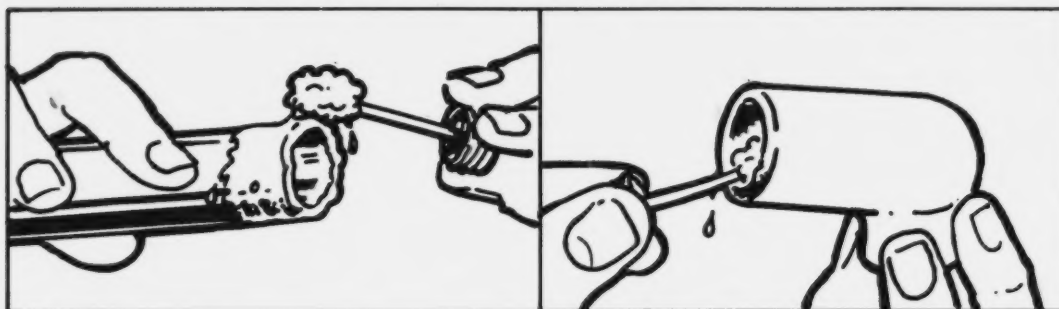
5. Trim off burrs on the inside and outside of the pipe end. Use a pocket knife or a round file. Bevel the outside edge of the pipe to keep the glue from being forced from the inside of the fitting.



6. Clean both male and female joints to remove all dirt and oily substances using emery cloth or cleaning solvent.
7. Assemble tube and fitting dry and make a mark across fitting and tube when the two pieces are in the final position.



8. Apply solvent as required for the appropriate type of plastic.
WORK QUICKLY, apply to both fitting and pipe.



NOTE!

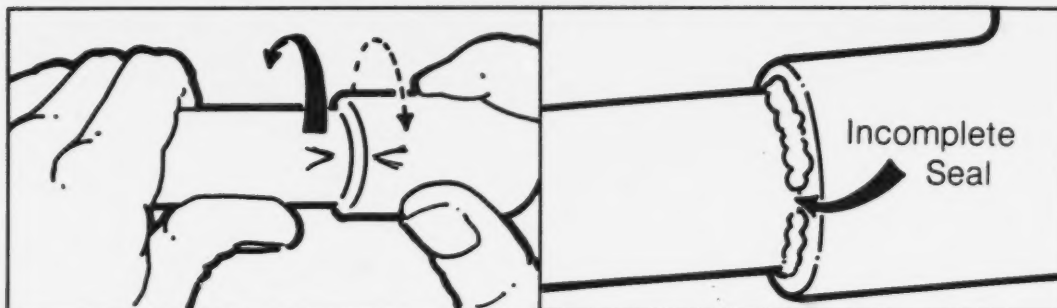
Read directions on can and follow closely.



CAUTION!

Fumes (Vapors) are harmful when inhaled.
Extreme caution is necessary.

9. Assemble pipe and fitting and twist one-half turn in one direction, then back to fitting mark to seal the joint. If seal is incomplete between the two pieces, pull apart, apply more solvent and refit together. Hold and count to ten slowly. Wipe off the excess solvent.



10. Clean your work area, replace all tools, and wash your hands.
11. Have your instructor check the pipe joint.



Building Trades - Plumbing
Working with Plastic Pipe

Unit Review

Directions: Match the equipment with their uses by writing the correct letter in each blank.

- | | |
|--------------------------------|--|
| _____ 1. Cleaning Solvent | A. Removes rough spots and burrs from cut ends of pipe |
| _____ 2. Pipe Solvent | B. Used to cut plastic pipe |
| _____ 3. Plastic Tubing Cutter | C. Cleans pipe ends and fittings before gluing |
| _____ 4. Round File | D. Glues and seals plastic pipe and fittings |

Directions: Circle the letter of the best answer.

5. The correct measurement to cut a pipe would be:
 - a. the exact measurement between the fittings.
 - b. the pipe measurement plus extra length to fit inside one of the fittings.
 - c. the pipe measurement plus extra length to fit inside both fittings.
6. An important step after cutting pipe is to:
 - a. Remove the burrs from the end.
 - b. bevel the pipe end.
 - c. use an emery cloth.
 - d. all of these answers.
7. What usually happens if there is an incomplete seal at the pipe joint?
 - a. the pipe will break
 - b. the pipe will leak
 - c. the joint will be stronger
8. Extreme caution should be taken around solvent fumes because:
 - a. fumes can melt the plastic pipe.
 - b. fumes prevent a tight-fitting joint.
 - c. fumes are harmful when inhaled.

Building Trades - Plumbing
Working with Plastic Pipe

Performance Checklist

Student _____ has successfully performed the following steps of procedure.

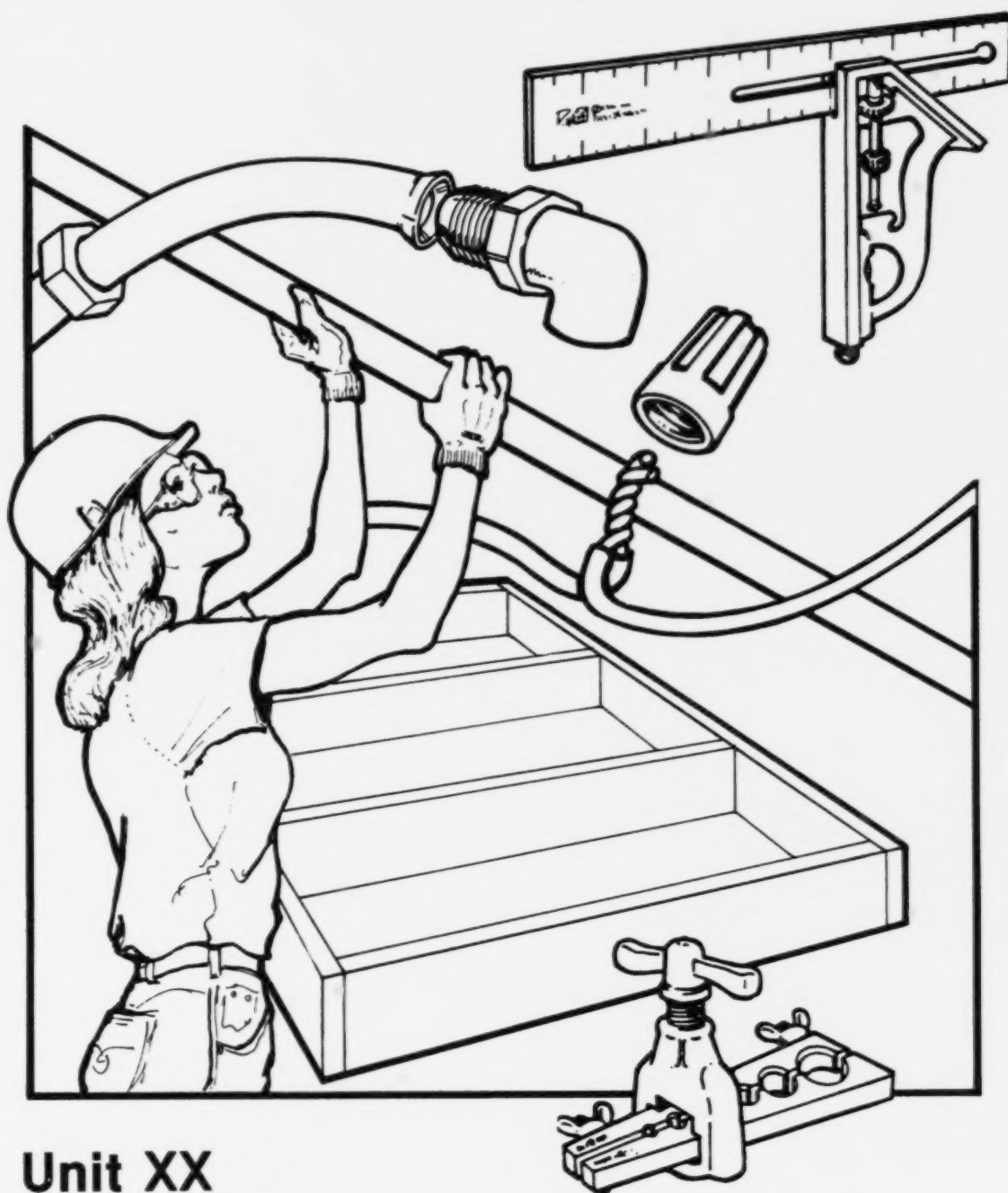
Working with Plastic Pipe	Yes	No	Comments
1. Assembled tools and equipment			
2. Wore safety equipment			
3. Measured and marked pipe			
4. Cut the pipe			
5. Trimmed and beveled the cut edges of the pipe			
6. Cleaned pipe and fitting with emery cloth and/or cleaning solvent			
7. Assembled and marked fitting on pipe			
8. Applied solvent to fitting and pipe			
9. Assembled and twisted fitting on pipe			
10. Reapplied solvent if seal was incomplete			
11. Wiped off excess solvent			
12. Washed hands			
13. Cleaned work area and put away tools and equipment			
14. Asked instructor to check joint			

Should Move On ☐

Repeat This Unit ☐

Student's Signature/Date

Instructor's Signature/Date



Unit XX

Working with Copper Pipe

Building Trades - Plumbing

Working with Copper Pipe

Working with Copper Pipe

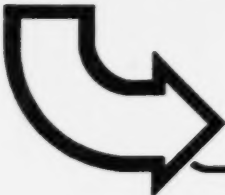
After studying this unit, you will be able to:

1. Measure and cut copper pipe, including allowance for fittings.
2. Flare copper pipe.
3. Install compression fittings in copper pipe.

Check the Statement that Fits You Best

☐

I can do these tasks and want to go through the Performance Checklist.



SEE YOUR INSTRUCTOR

☐

I want to study the information in this unit before I do the Performance Checklist.



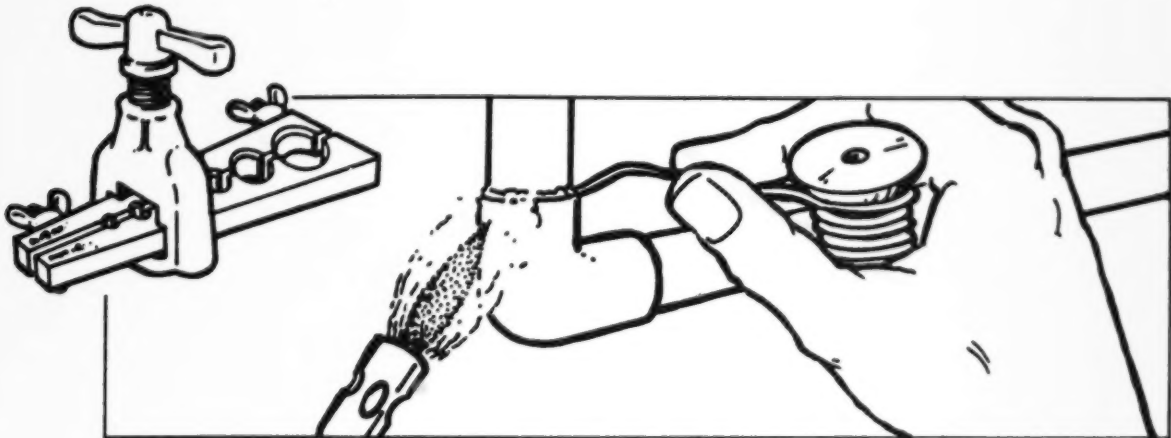
TURN PAGE AND BEGIN

Building Trades - Plumbing
Working with Copper Pipe

Introduction

There are two types of copper tubing; flexible, and rigid. Both types can be sweat fitted (soldered), and the flexible tubing can also accept compression, tap-on, and flare fittings.

Rigid copper tubing is measured in the same manner as threaded pipe. Allowance is made for the fitting dimensions (solder or compression type) and for the distance the pipe is inserted into the fitting. Measurements for the flexible tubing require less accuracy and no fittings for the bends.



Copper tubing is used in most residential supply lines for fixtures. Copper does not corrode, as does the iron pipe, has great versatility in its applications, and requires little time and few tools. Its drawback is the use of a torch to heat the pipe and solder in the very flammable walls of structures.

TURN TO NEXT PAGE

Building Trades - Plumbing
Working with Copper Pipe

A. Terms and Definitions

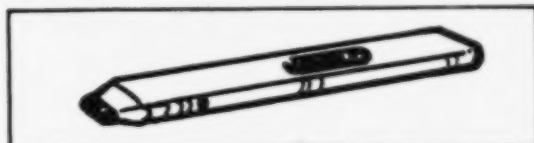
1. Insulation Sheets - used to protect wood the copper pipe is hung on by deflecting the flame and heat.
2. Emery Cloth - a fine abrasive powder glued onto cloth, ususally torn into strips to clean the ends of pipe before soldering.
3. Flaring Tool - a portable vise-like tool that compresses the cut end of copper tubing into a 45° flare.
4. Propane Torch - used to heat the pipe and solder to make sweat fittings on copper pipe.
5. Sparklighter - tool which shoots sparks to light the propane torch.
6. Solder - composed of percentages of Tin and Lead. 60-40 solder is 60% Tin and 40% Lead. It melts at 370° F. 40-60 solder melts at 460° F.

Building Trades - Plumbing
Working with Copper Pipe

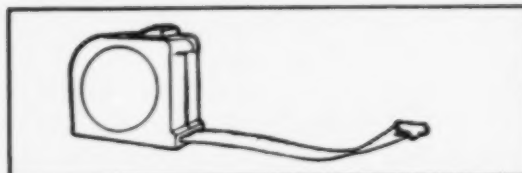
B. Measuring, Cutting, and Sweating of Copper Pipe

1. Assemble all tools and equipment needed to measure, cut, and solder copper pipe.

Pencil



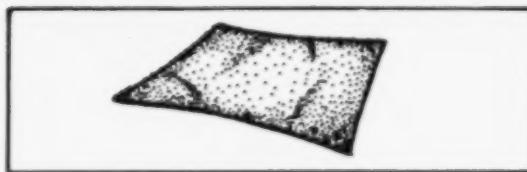
Tape Measure



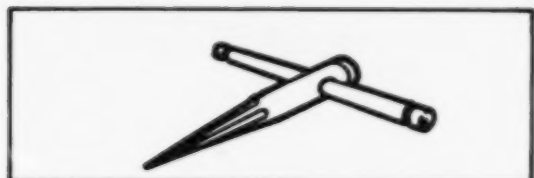
Tubing Cutter



Emery Cloth



Reamer



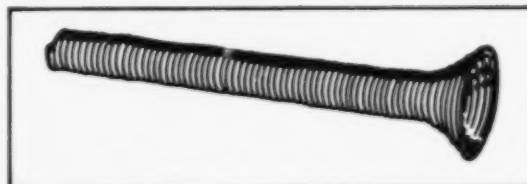
Soldering Paste



Sparklighter



Tubing Bender

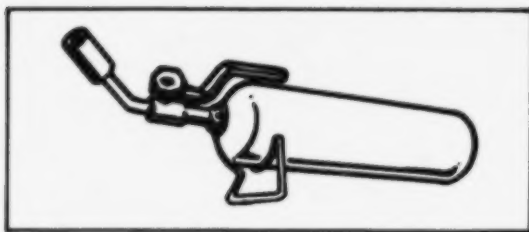


Safety Equipment

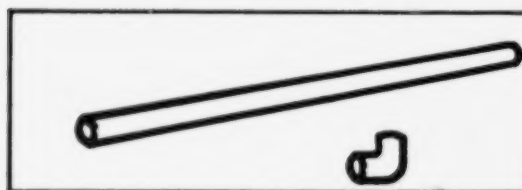


Solder

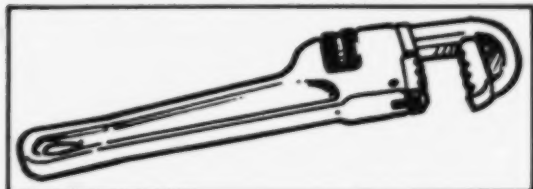




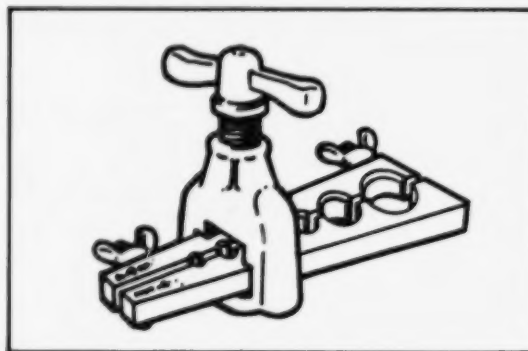
Propane Torch



Copper Tubing and Fitting

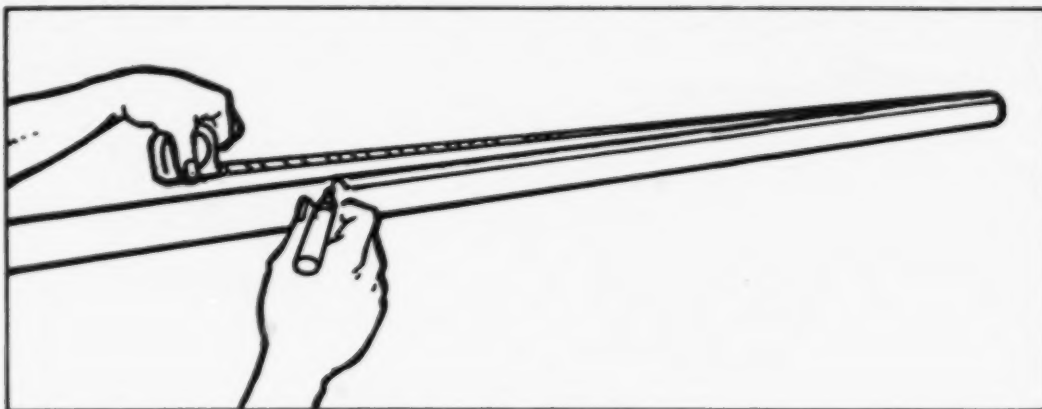


Adjustable Wrench

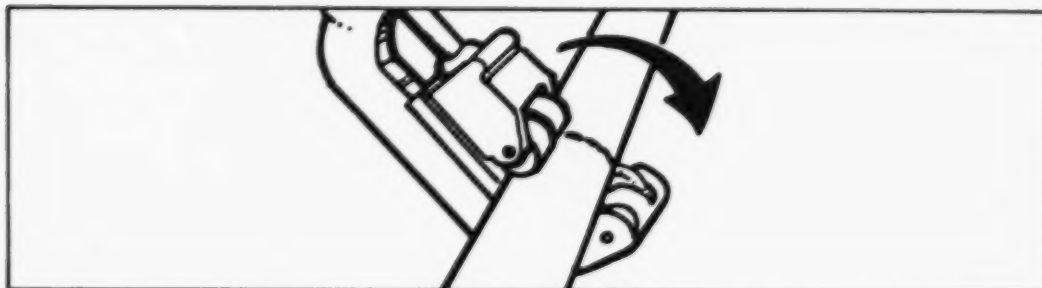


Flaring Tool

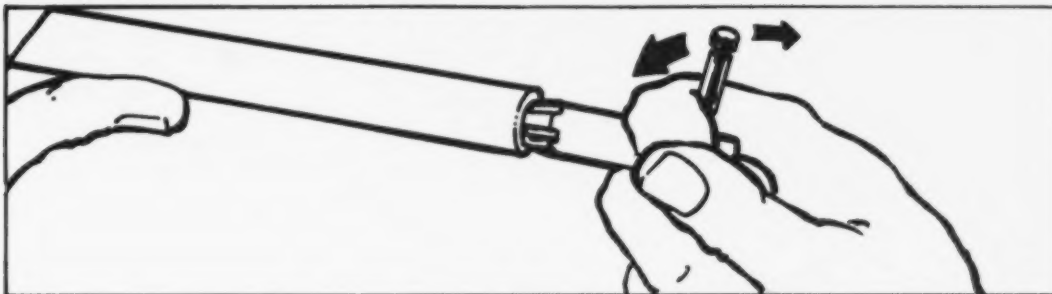
2. Measure the length of tubing needed.



3. Cut the copper pipe with the tubing cutter.



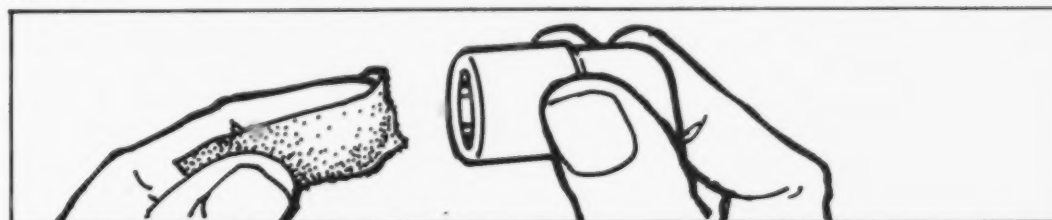
4. Ream the ends of the pipe.



5. Use the emery cloth to clean the outside of the pipe end to one inch from the end.



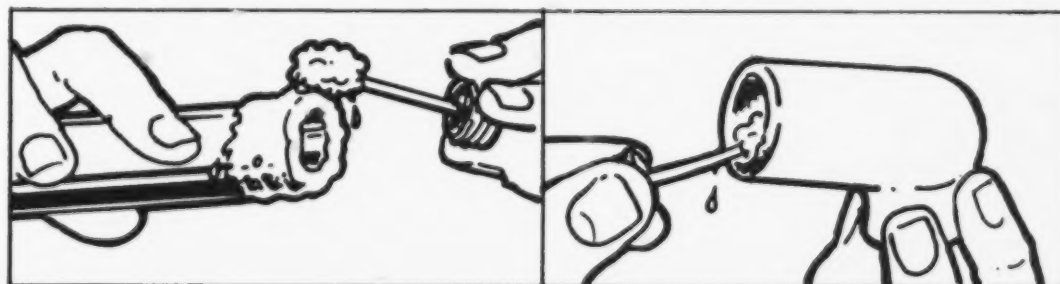
6. Clean the pipe fitting to be mounted with the emery cloth on the inside.



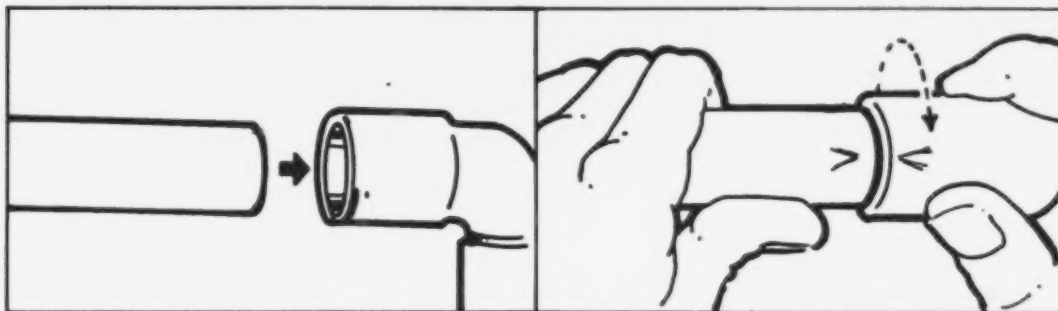
NOTE!

DO NOT TOUCH the cleaned metal. Your fingers will leave dirt, oil, and corrosion on the metal.

7. Apply soldering paste to the pipe and to the fitting.



8. Push the pipe into the pipe fitting. Turn the pipe until it is properly aligned and tight within the pipe fitting.



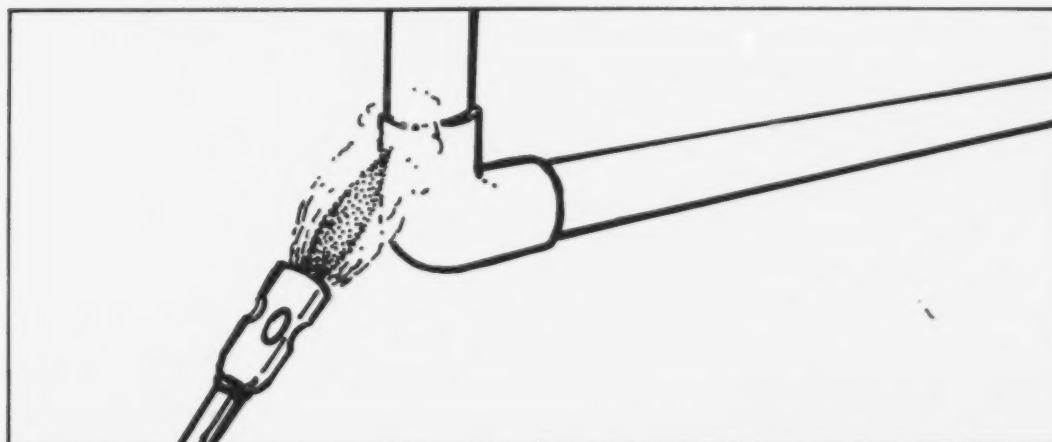
9. To light the propane torch, set the torch in an upright position. Turn the gas valve one half turn to the left to open. Strike the sparklighter at the torch nozzle. Allow the torch to warm up several minutes before use or turning it on its side.



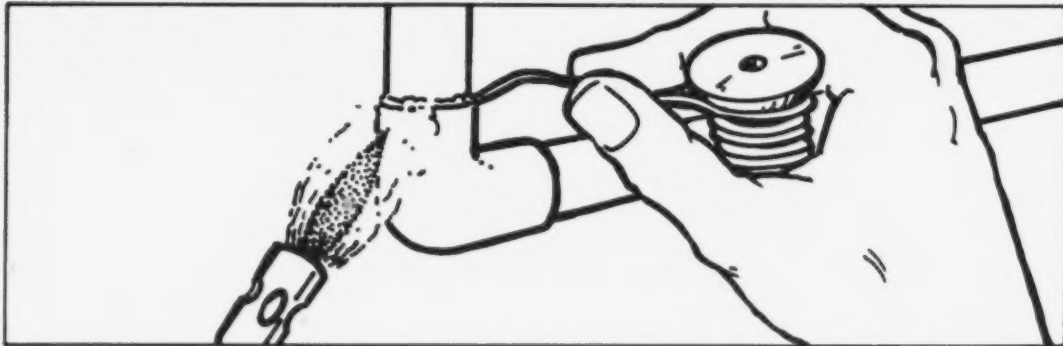
CAUTION!

Always use a sparklighter to light a propane torch.

10. Heat the copper tube and fitting by holding the inner blue cone of flame on the metal. Try to keep the propane tank as near to vertical as possible.



11. Do not overheat the joint. Touch the solder slowly against the heated joint. Move the torch flame to the center of the fitting to maintain heat. Apply solder completely around the joint.



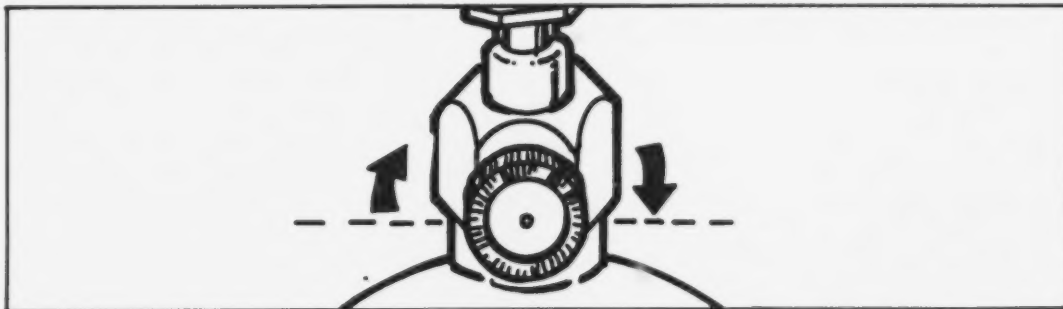
12. Wipe off any excess solder while it is still molten.



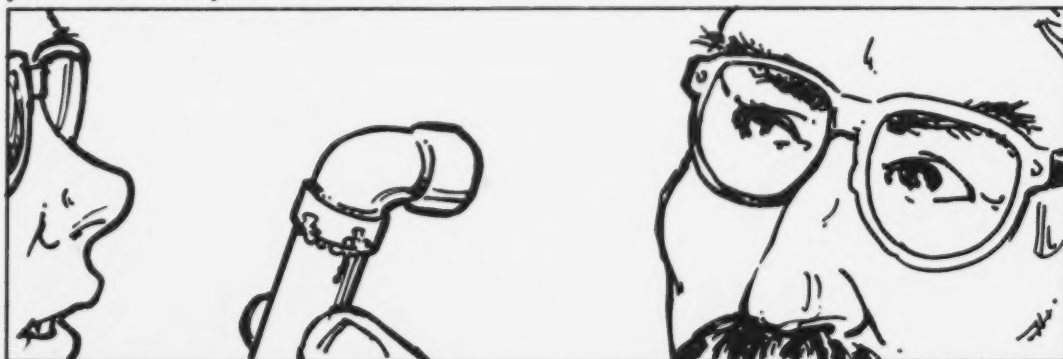
CAUTION!

DO NOT Touch the soldered joint with your bare hand, it will burn you.

13. Shut off the propane tank by turning the valve back to the right.



14. Clean up your work area and return tools to their places. Show your work to your instructor.

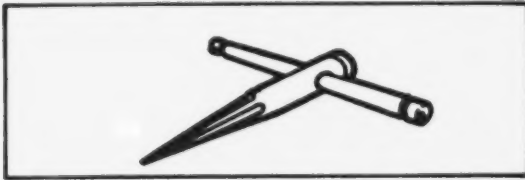


Building Trades - Plumbing
Working with Copper Pipe

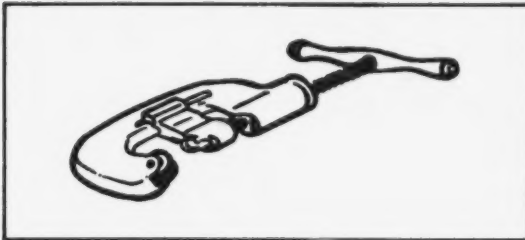
C. Assembling a Flared Compression Fitting

1. Assemble tools and materials needed for compression type fittings of copper pipe.

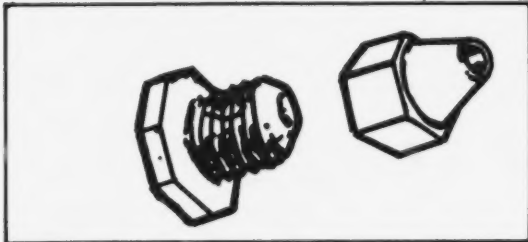
Reamer



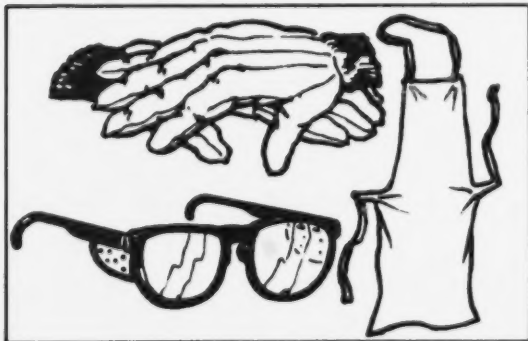
Tubing Cutter



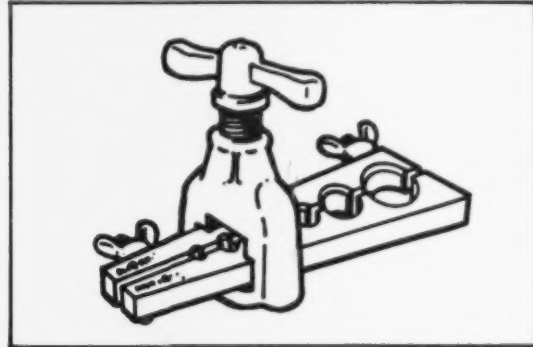
Compression Fitting



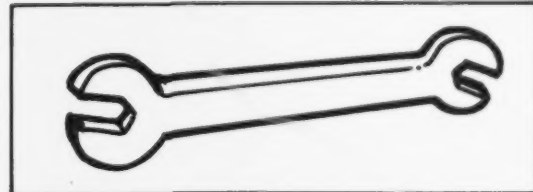
Safety Equipment



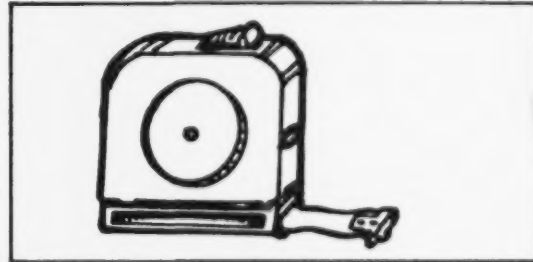
Flaring Block



Wrenches



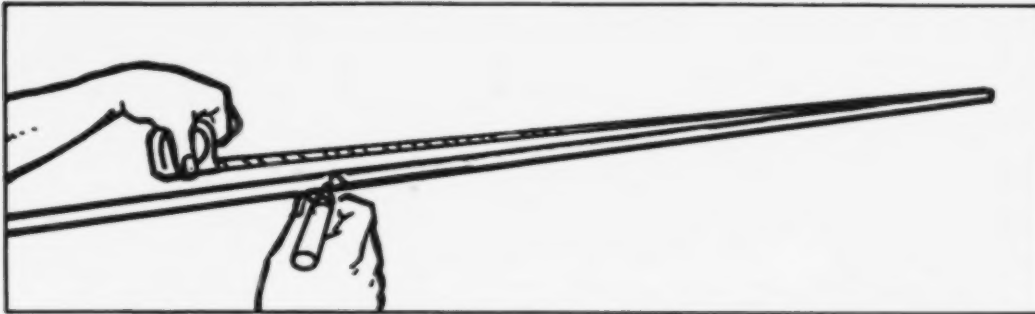
Tape Measure



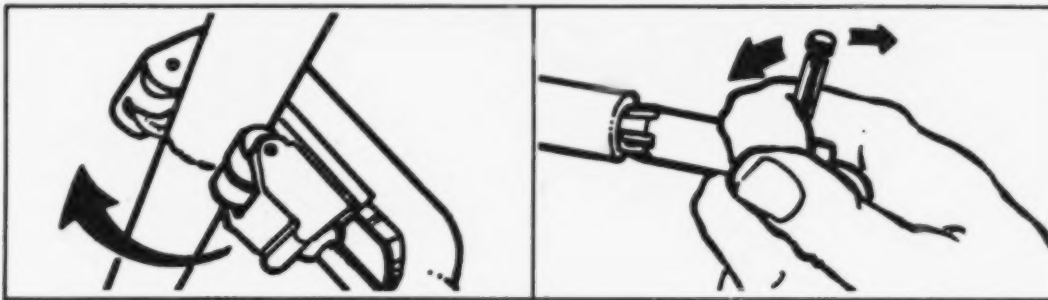
Pencil



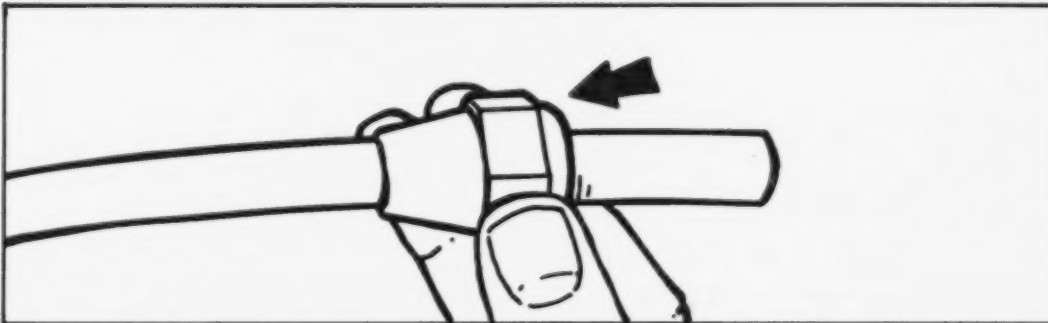
2. Measure and mark the length of pipe needed.



3. Use a pipe cutter to cut the pipe at the mark. Ream the end and inspect for out-of-roundness and burrs.

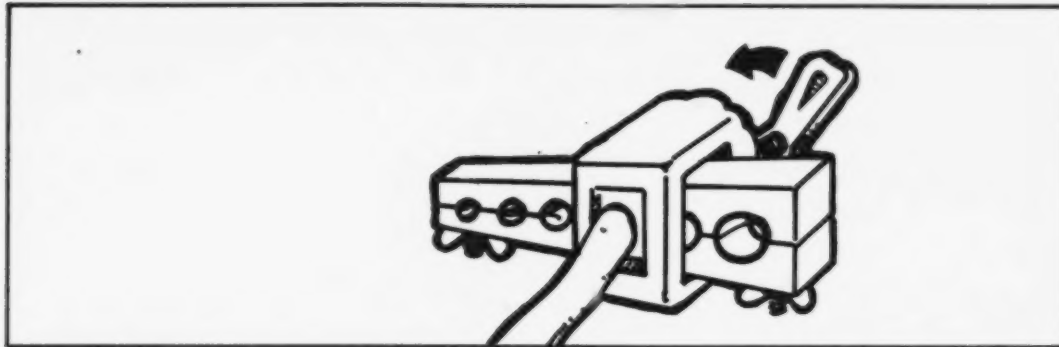


4. Remove a flange nut from the fitting and slide it onto the pipe with the unthreaded end first.

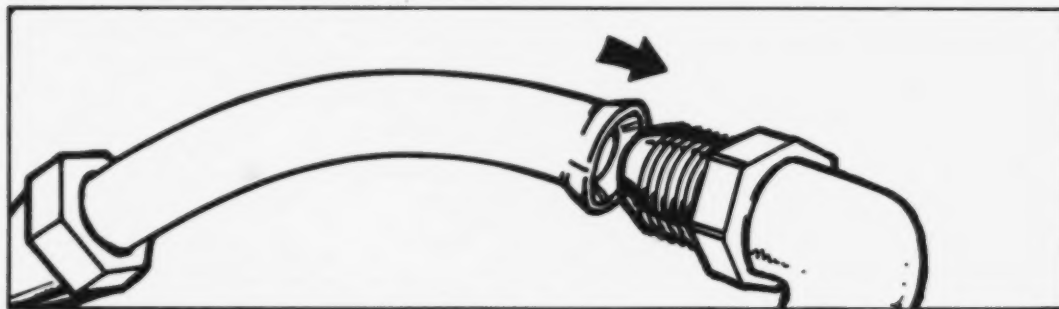


5. Flare the end of the tube with a flanging tool. Place the tube in the proper size hole with the end of the tube level with the surface of the tool. Turn the cone clockwise until the flare on the tubing fills the beveled shoulder of the hole.

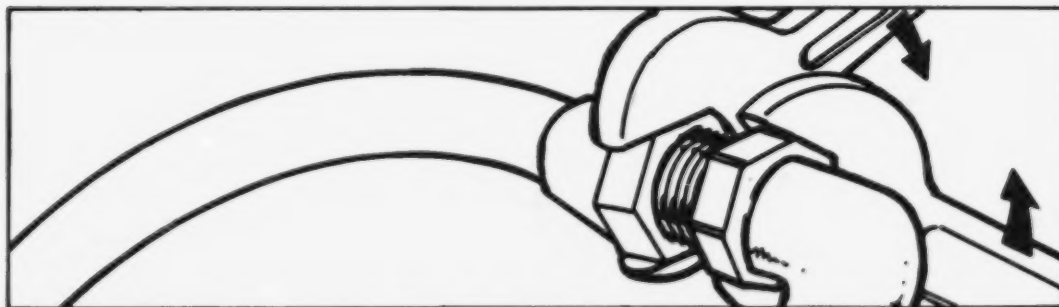




6. Remove the tubing from the flaring tool. Place the flared end of the tubing on the fitting.



7. Slide the flange nut down to the fitting and screw them together until tight. Tighten with wrenches.



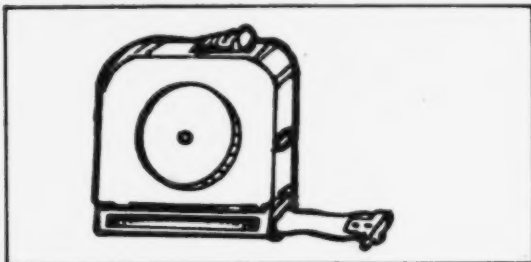
8. Clean your work area and return tools to their proper places. Have your instructor examine your work.

Building Trades - Plumbing
Working with Copper Pipe

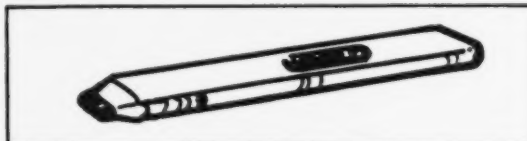
D. Assembling an Unflared Compression Fitting

1. Assemble materials and tools needed to make a compression fitting.

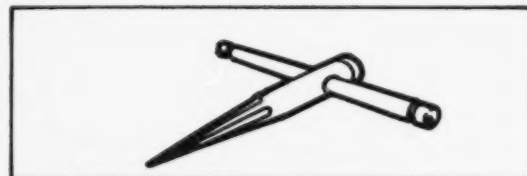
Tape Measure



Pencil



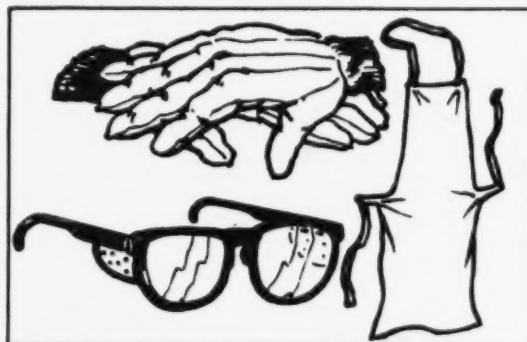
Reamer



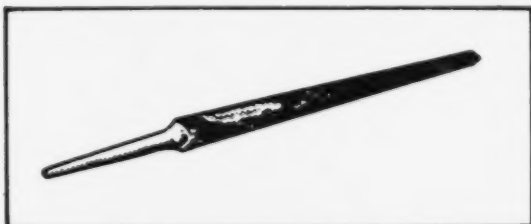
Wrenches



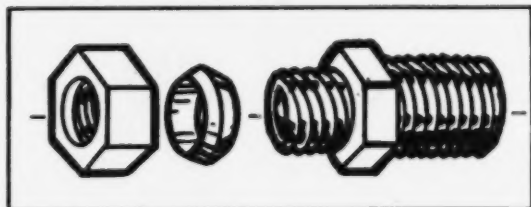
Safety Equipment



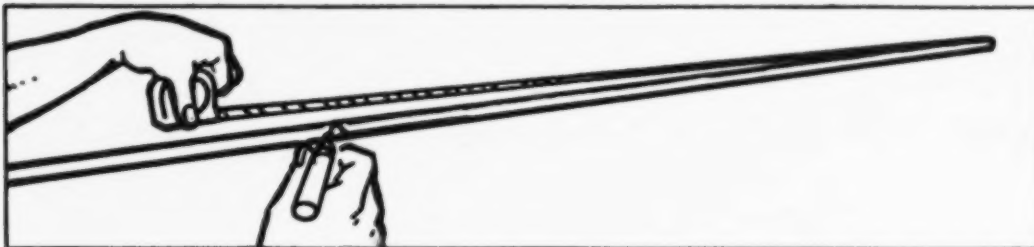
File



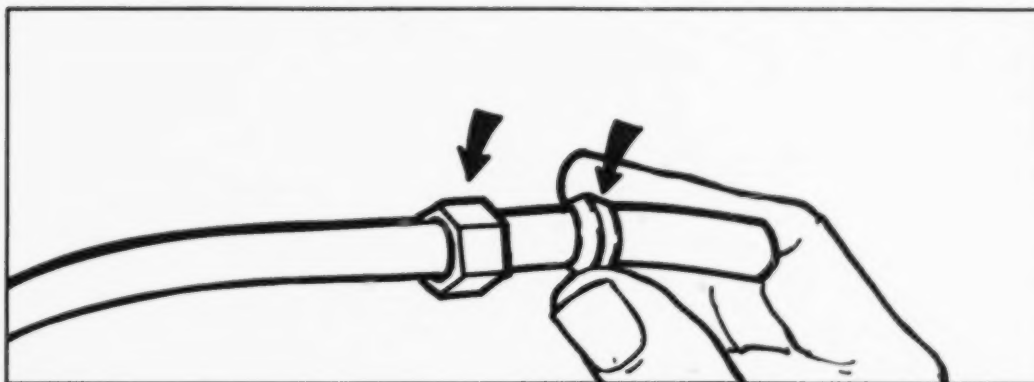
Compression Fitting



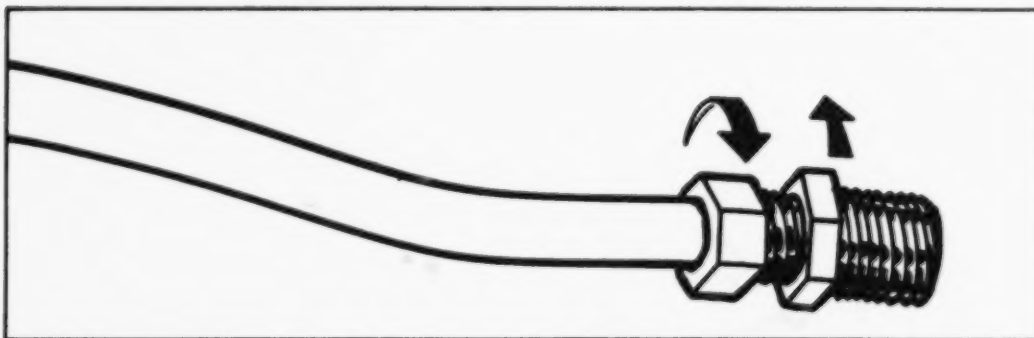
2. Measure and mark the length needed on the copper tubing. Use a tubing cutter to cut the tube to the length. Ream and file the end of the tube. Inspect the tube for nicks, burrs, and out-of-roundness.



3. Slide the unthreaded end of the flange nut onto the copper tubing. Slide the compression ring onto the tubing.



4. Insert the end of the tubing into the fitting as far as possible. Holding the end of the tubing tightly against the fitting, slide the flange nut down to the fitting and thread it by hand. Use a wrench to tighten the flange nut.



5. Clean your work area and return all tools to their places. Show your work to your instructor.

Building Trades - Plumbing
Working with Copper Pipe

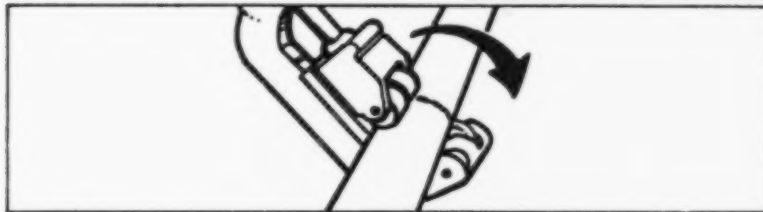
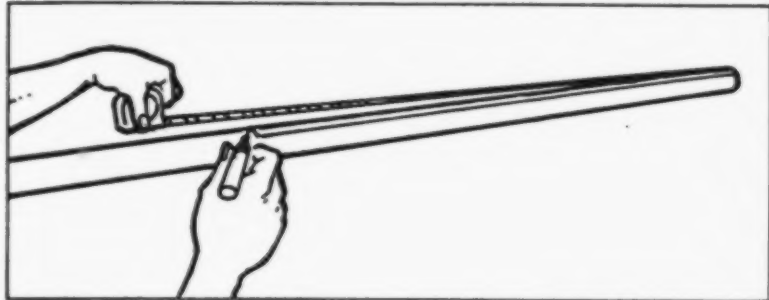
Unit Review

Directions: Put the illustrations in their correct order by numbering them 1 through 6 in the blank spaces.



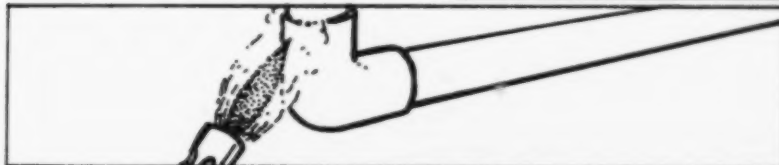
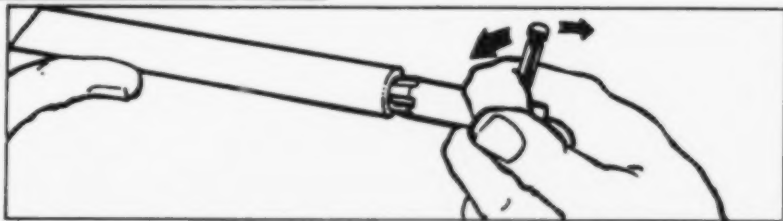
A. _____
Push pipe into fitting and align.

B. _____
Measure the length of tubing needed.



C. _____
Cut the copper pipe.

D. _____
Ream the ends of the pipe.



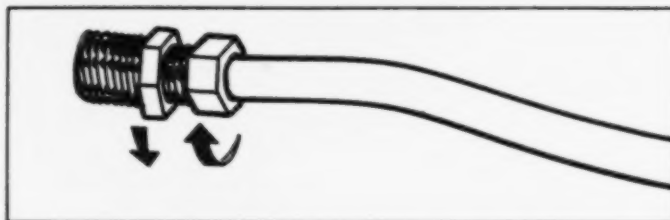
E. _____
Heat the tube and fitting and apply the solder.

F. _____
Apply soldering paste.

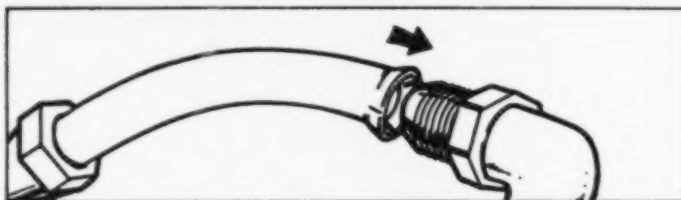


Directions: Write the name of the fitting in each of the illustrations below.

1. _____



2. _____



Building Trades - Plumbing
Working with Copper Pipe

Performance Checklist

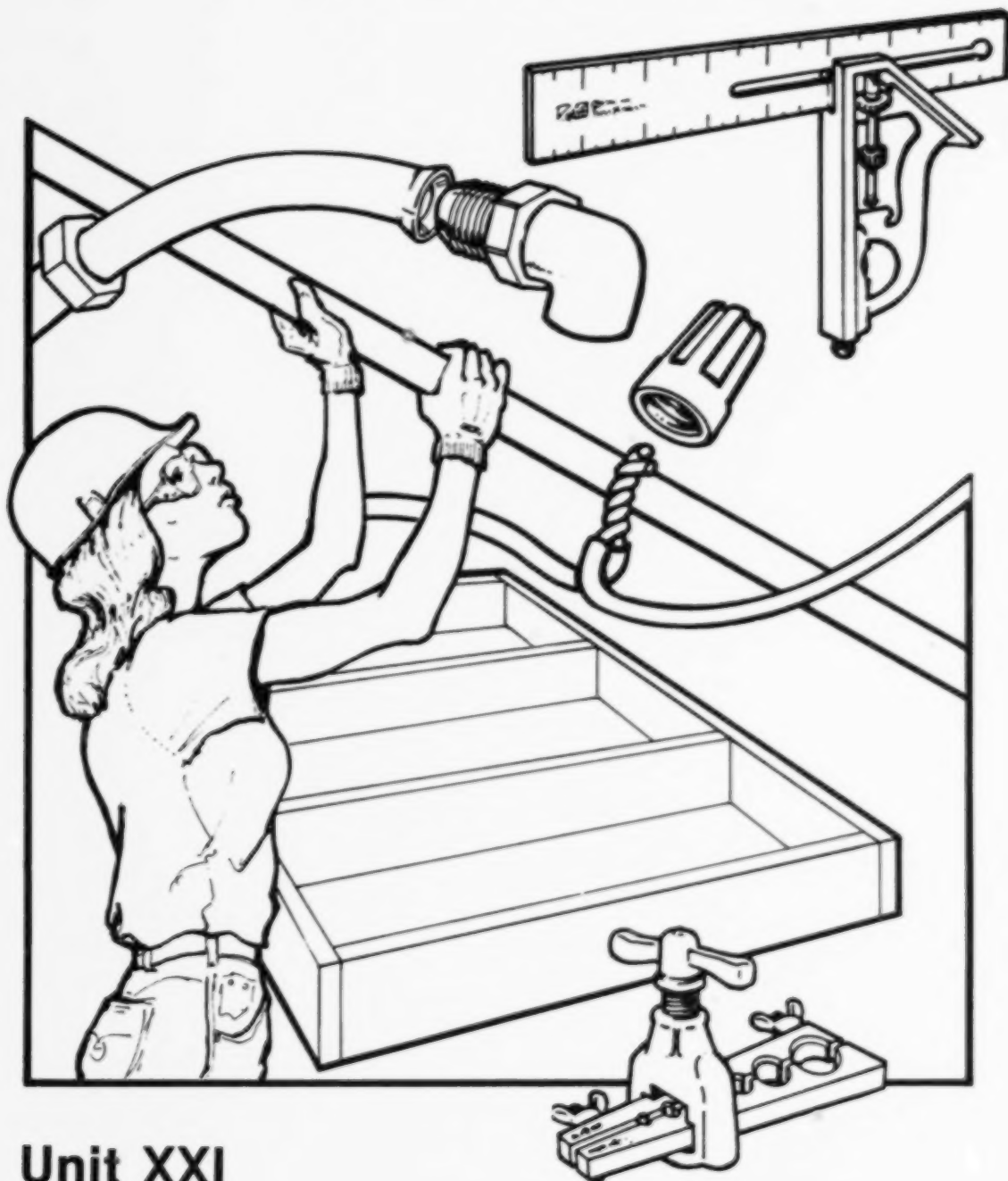
Student _____ has successfully performed the following steps of procedure.

Measuring, Cutting and Sweating Copper Pipe	Yes	No	Comments
1. Assembled equipment and tools			
2. Measured correct length of pipe			
3. Cut copper pipe			
4. Reamed end of pipe			
5. Used emery cloth to clean pipe and fitting			
6. Applied soldering paste to pipe and fitting; fit them together			
7. Lit the propane torch			
8. Heated copper pipe and sweated solder onto the pipe			
9. Shut off propane torch			
10. Showed work to instructor			
Assembling Flared Compression Fitting			
1. Assembled tools and equipment			
2. Measured and cut correct length of pipe			
3. Placed flange nut on the copper pipe			
4. Flared one end of the copper pipe with flaring tool			
5. Placed flared end of copper pipe onto fitting			
6. Screwed flange nut together to complete fitting			
7. Had instructor examine fitting			
8. Cleaned work area			
Assembling Unflared Compressing Fitting			
1. Assembled materials and tools			
2. Measured, marked, and cut copper pipe to correct length			
3. Slid flange nut and compression ring onto copper pipe			
4. Inserted copper pipe into fitting, held tightly, and tightened flange nut together			
5. Showed instructor finished fitting			
6. Cleaned work area			

Should Move On ☐
Repeat This Unit ☐

Student Signature/Date _____

434 Instructor Signature/Date _____



Unit XXI

Working with Steel Pipe

Building Trades - Plumbing
Working with Steel Pipe

Working with Steel Pipe

After studying this unit, you will be able to:

1. Identify tools and materials necessary to measure and cut steel pipes.
2. Measure and cut steel pipes.
3. Ream and thread steel pipes.
4. Connect steel pipes to fittings.

Check the Statement that Fits You Best

☐

I can do these tasks and want to go through the Performance Checklist.



SEE YOUR INSTRUCTOR

☐

I want to study the information in this unit before I do the Performance Checklist.



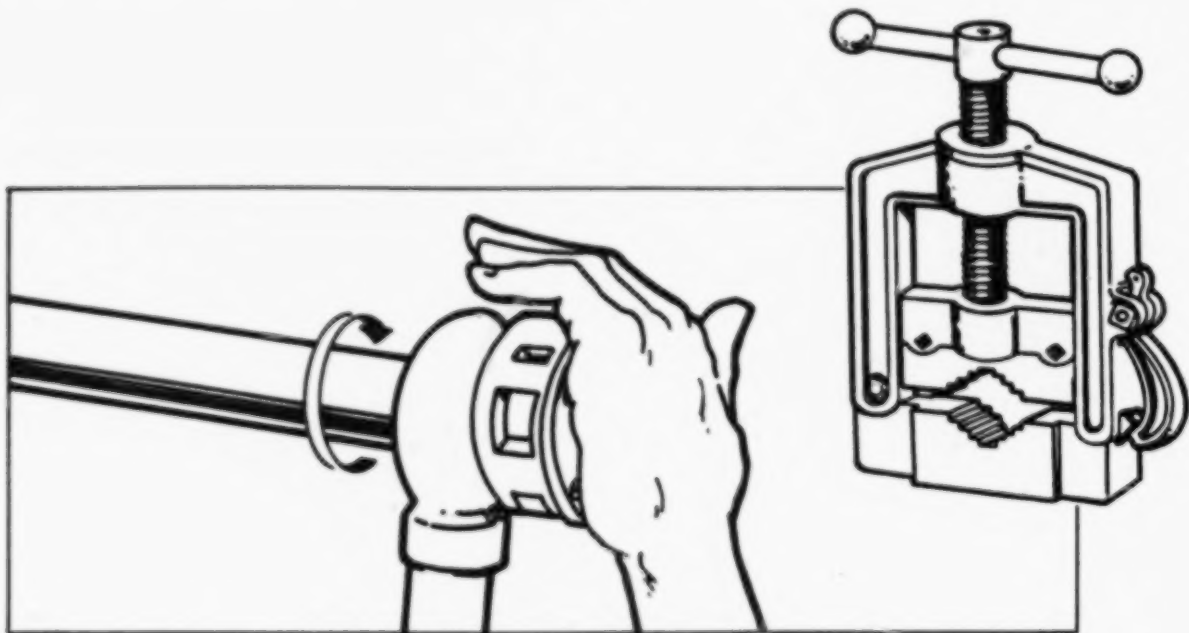
TURN PAGE AND BEGIN

Building Trades - Plumbing
Working with Steel Pipe

Introduction

Threaded steel pipe has traditionally been used more often than any other type of pipe. You will have to learn to work with steel pipe to work on any but the newest of plumbing installations.

The biggest drawback of steel pipe is its lack of flexibility. Measurements must be very accurate. Steel pipe calls for more tools, skill, and time than any other type of pipe.



In this unit you will learn to measure, cut, ream, thread, and connect steel pipes.

TURN TO NEXT PAGE

Building Trades - Plumbing

Working with Steel Pipe

A. Tools and Equipment

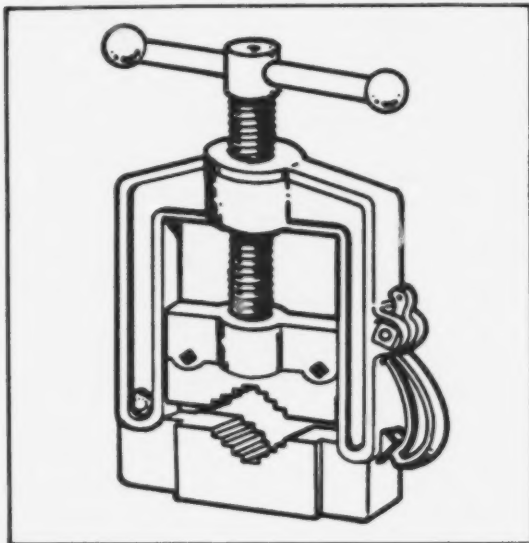
1. Pipe Cutter - is a special tool used to cut pipe cleanly before threading and joining.
2. Pipe Dies - are cutter pieces with different inside diameters placed in the head of the pipe threader.
3. Pipe Joint Compound - is applied to pipe threads to prevent leaking threads.
4. Pipe Reamer - removes the inside burr from cut iron pipes. This prevents stoppages.
5. Pipe Vise - holds pipe securely when cutting, reaming, or threading.
6. Wrench - loosens or tightens a joint by biting into and holding onto a pipe as you turn it.

Building Trades - Plumbing
Working with Steel Pipe

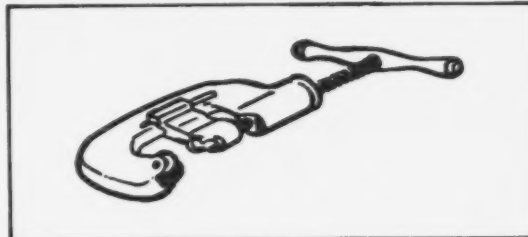
B. Measuring and Cutting Steel Pipe

1. Assemble all materials and tools needed.

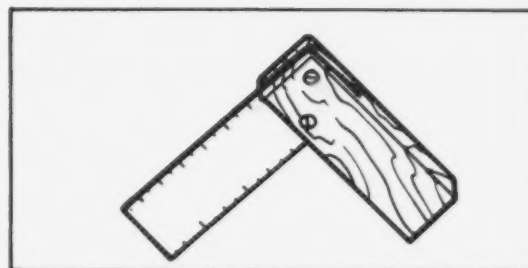
Pipe Vise



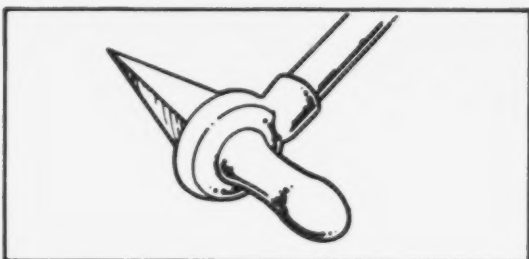
Pipe Cutter



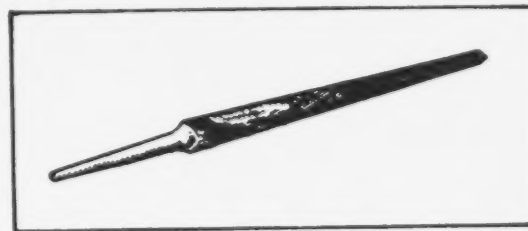
Tri Square



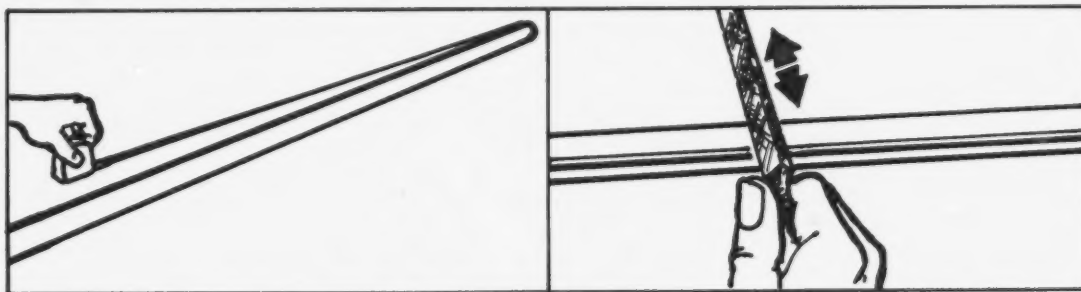
Pipe Reamer



File

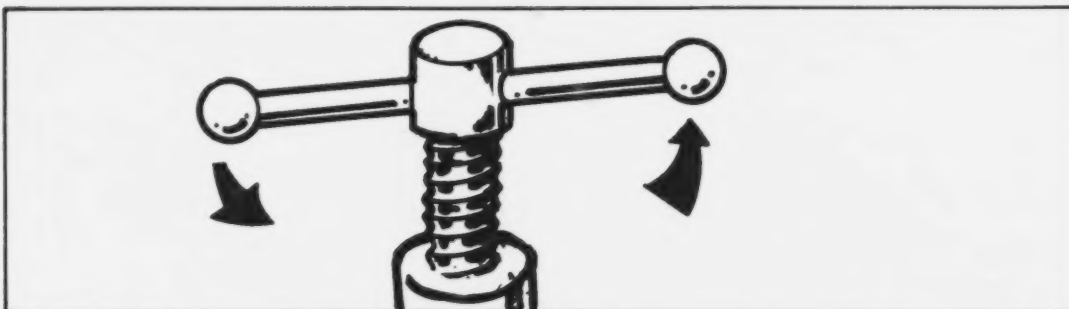


2. Measure the correct length of pipe to be cut.
3. Use a triangular file to mark where the pipe is to be cut.

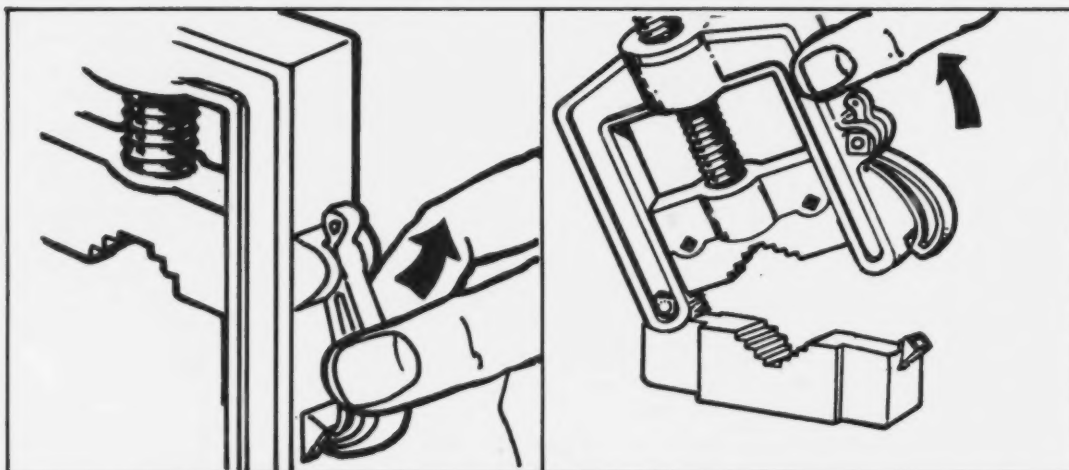


The hinged vise has a fixed toothed lower jaw and a moveable, toothed, upper jaw. The procedure for use of the vise is as follows:

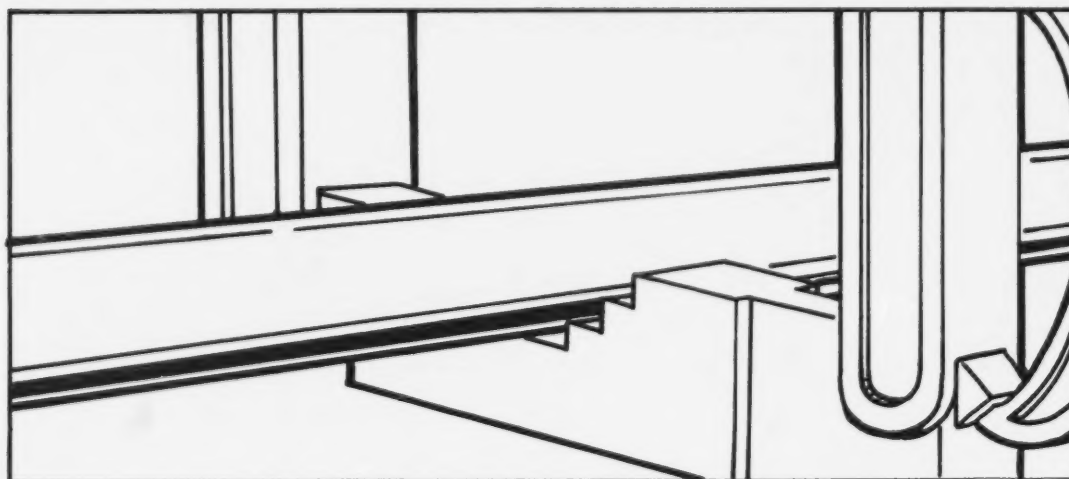
4. Release the the pressure on the jaws of the vise by turning the handle counterclockwise.



5. Release the locking lever by pulling outward on the lever. Then open the vise by tilting the upper body to the side on its pivot.



6. Lay the pipe in the vise on the V-shaped lower jaw.



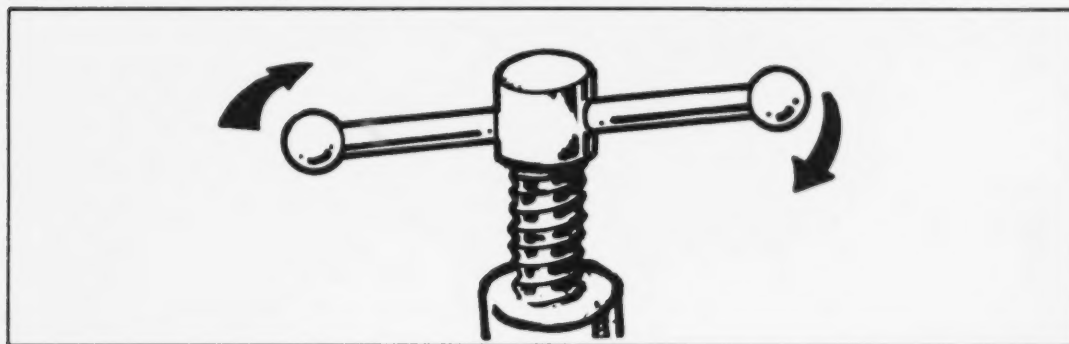
7. Tilt the upper body back to the closed position. The lever automatically locks.



NOTE!

When working with polished or plated pipe, protect it from being scratched by the steel jaws on the vise. A pipe coupling, split lengthwise and lined with sheet lead, makes a good clamp to use in the vise.

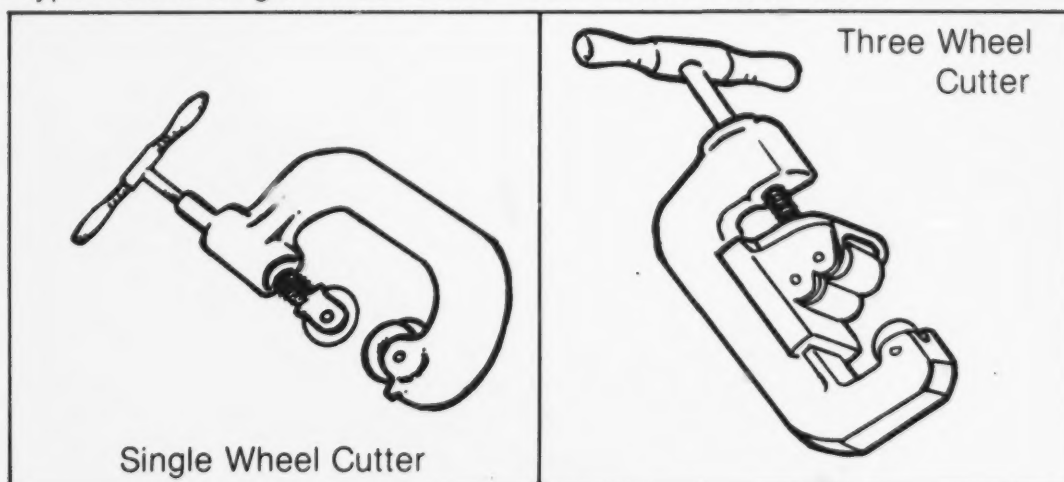
8. Turn the handle clockwise until the V-shaped upper jaw clamps the pipe. Turn the handle only far enough to get a good grip on the pipe. Avoid turning the handle too hard and marking the pipe.



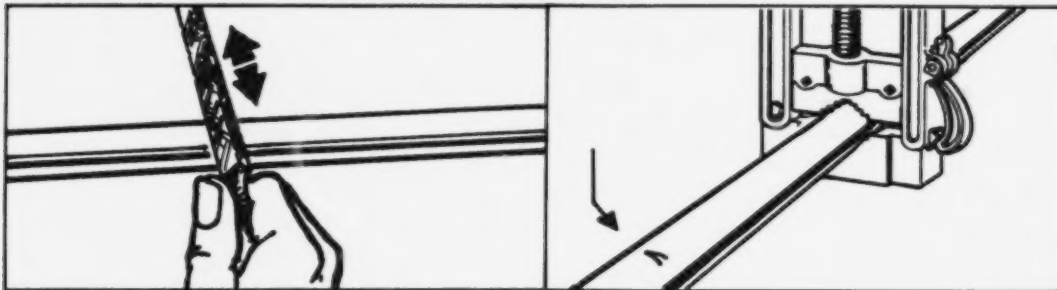
CAUTION!

Do NOT tighten the cutting wheel too tightly against the pipe. You will bend the pipe.

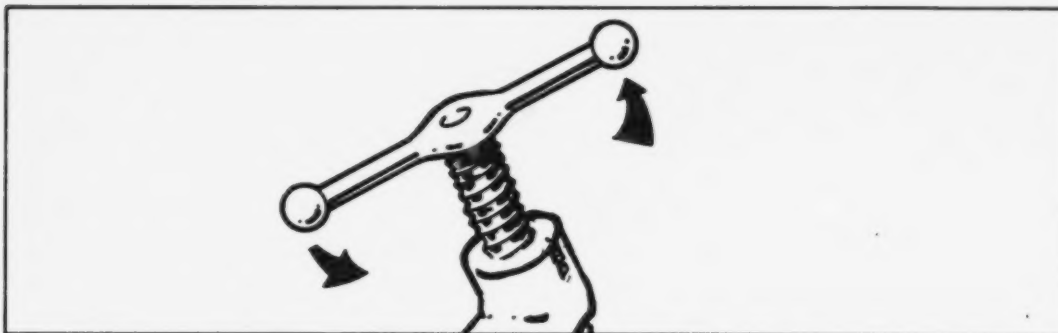
Use the pipe cutter with no nicks or burrs on the cutting wheels. The two main types are a single wheel cutter and a three wheel cutter.



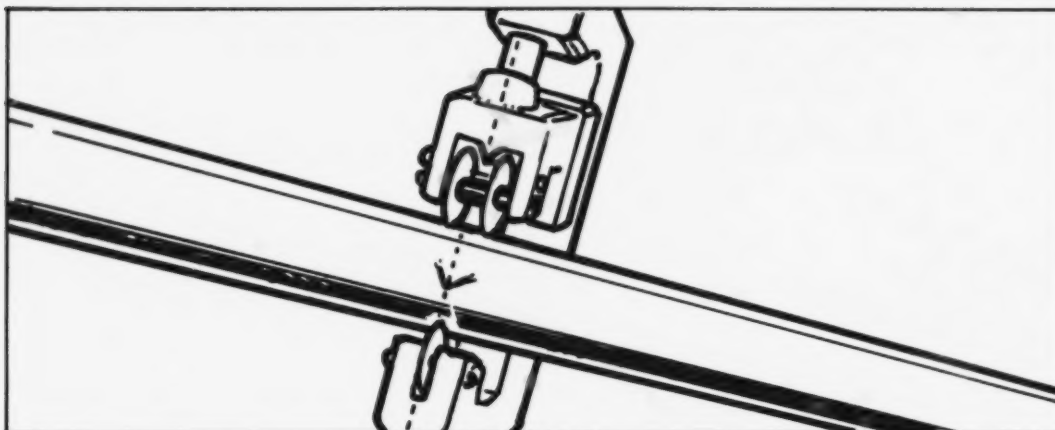
9. Determine the length of the pipe needed and mark the spot where the cut is to be made with the file.
10. Lock the pipe in the vise with the cutting mark about 8 inches from the vise.



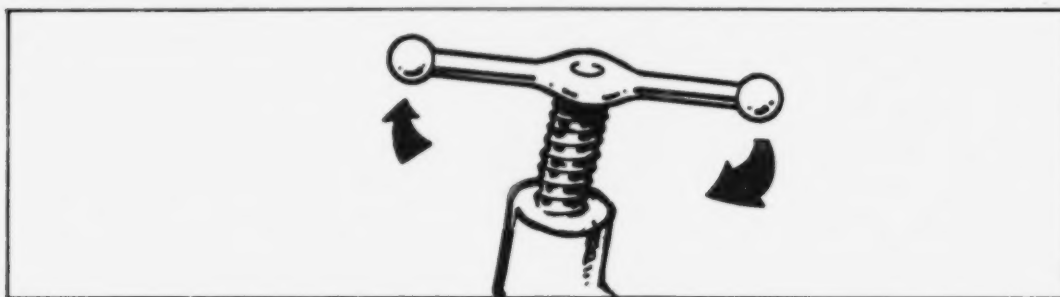
11. Open the jaws of the pipe cutter by turning the handle counterclockwise.



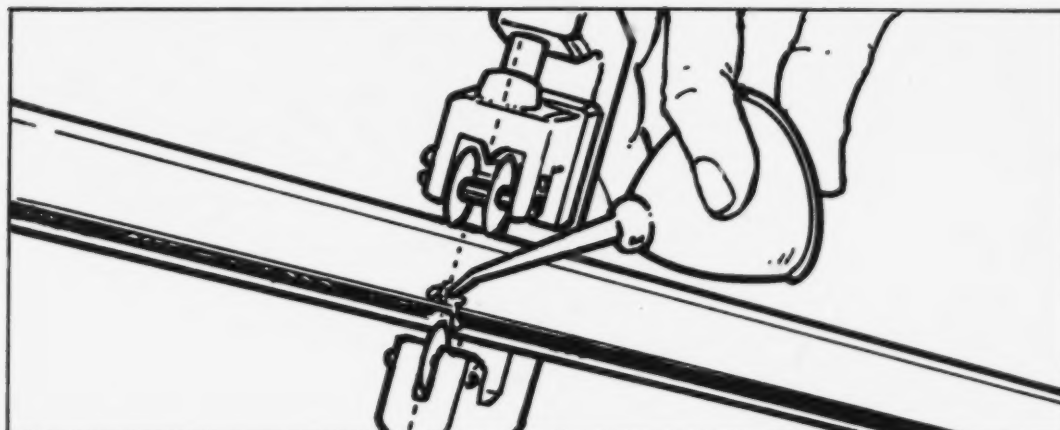
12. Place the cutter around the pipe from underneath with the cutting wheel exactly around the mark. The rollers of the single wheel cutter insure a straight cut. If a three wheel cutter is used, place the moveable jaw on the mark. Make sure that all three wheels are at right angles to the centerline of the pipe.



13. Turn the jaws lightly against the pipe by turning the handle clockwise.



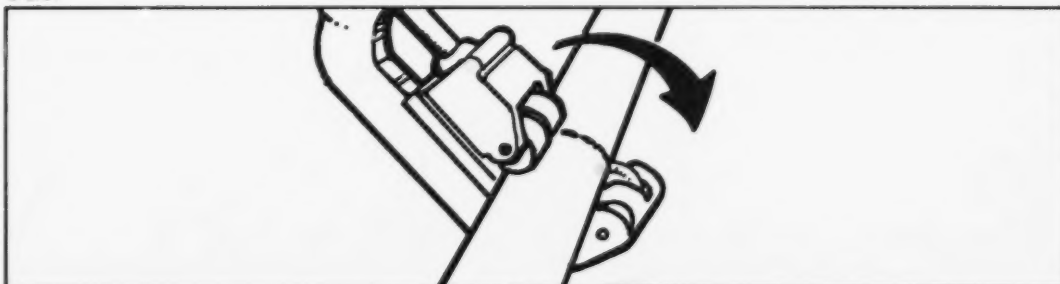
14. Make another clockwise quarter turn on the handle. This gives the wheels a bite on the pipe. Apply cutting oil to the wheels and pipe.



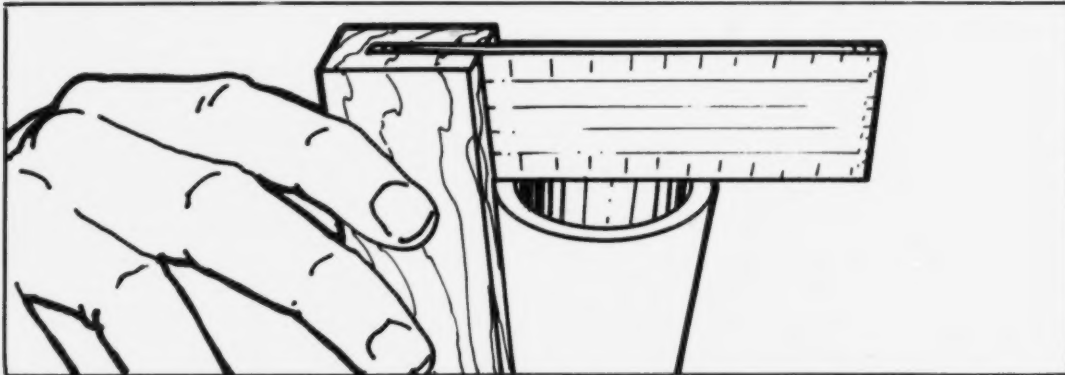
CAUTION!

Do NOT tighten the cutting wheel too tightly against the pipe. You will bend the pipe.

15. Rotate the cutter completely around the pipe, making a quarter turn on the handle for each complete revolution, until the pipe is cut.



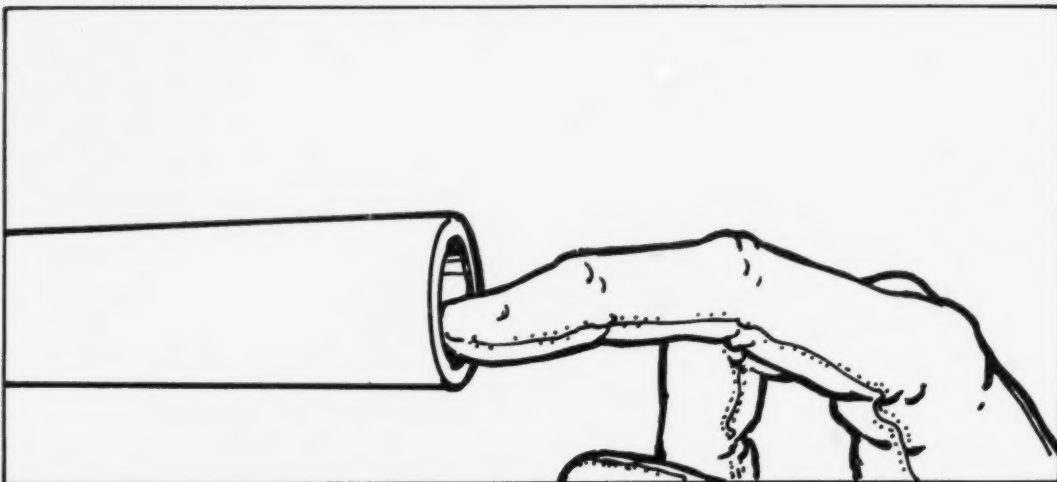
16. Check the squareness of the cut end with a tri-square. You should have made a 90° cut.



17. Push the reamer into the pipe. Turn the reamer clockwise in short even strokes. Keep a steady pressure against the pipe, until the inside burr is removed.



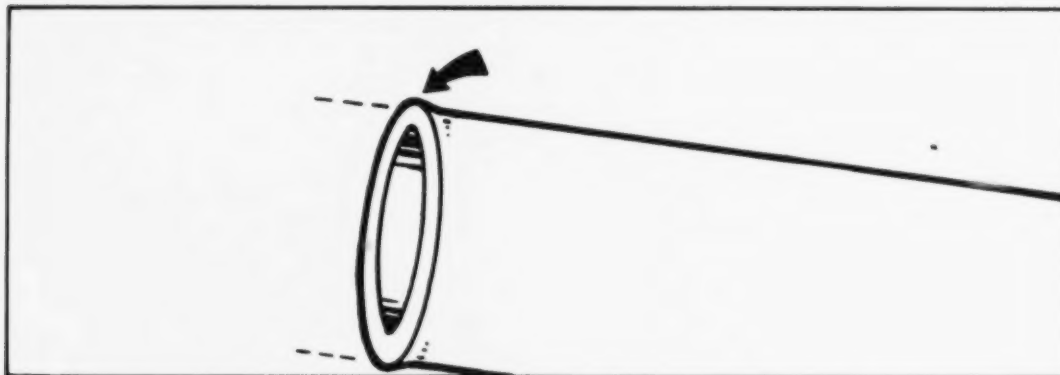
18. Remove the reamer. Run a cloth or your gloved finger around the inside edge to feel if the sharp edge has been removed.



**NOTE!**

Do NOT ream more than is necessary or you will weaken the thread you cut.

19. If the pipe has been cut with a three wheel cutter, the outside burr must be removed with a file before the pipe can be threaded.



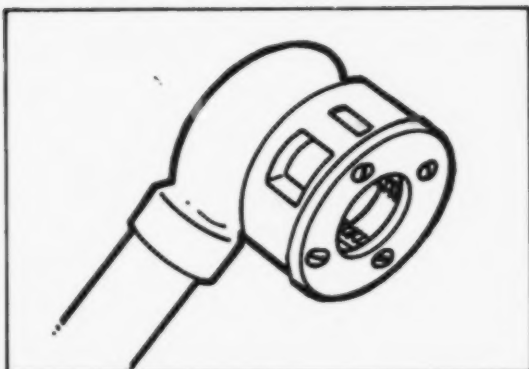
20. Have your instructor check your cutting and reaming.

Building Trades - Plumbing
Working with Steel Pipe

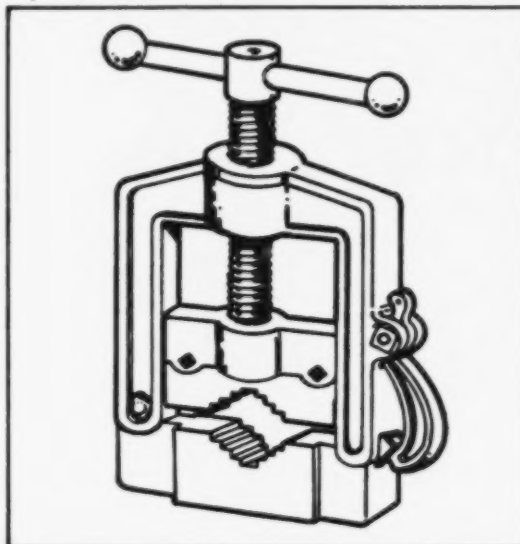
C. Threading Steel Pipe

1. Assemble tools and materials needed to thread steel pipe.

Pipe Threading Die



Pipe Vise



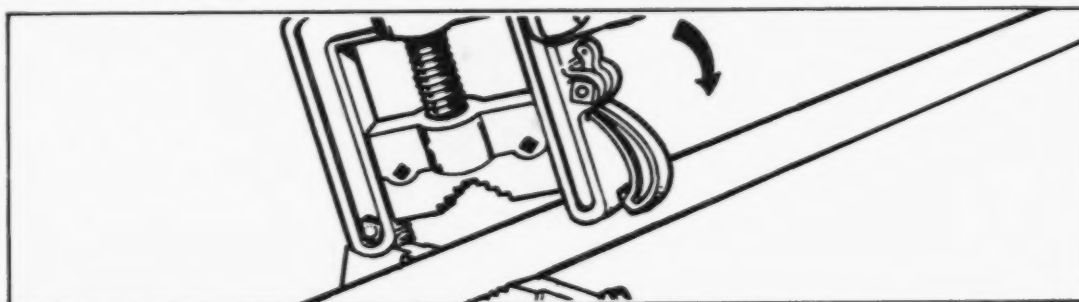
Threadcutting Oil



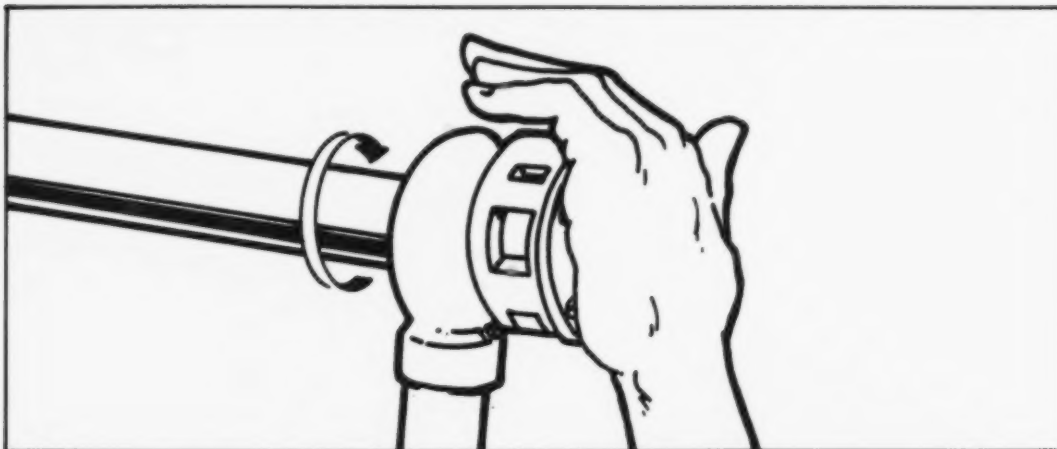
Safety Equipment



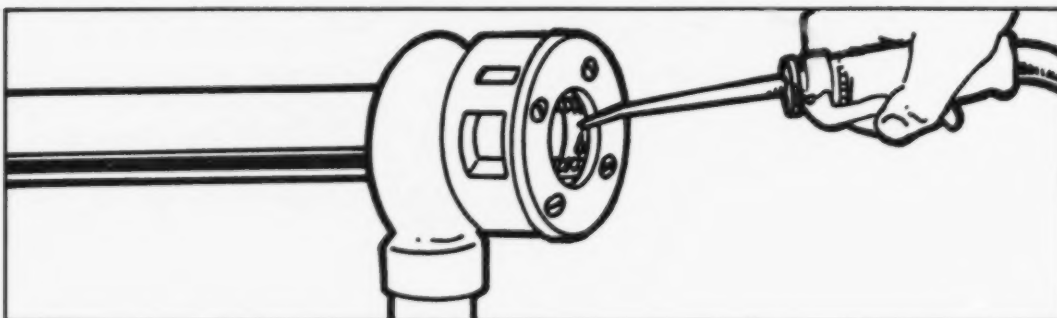
2. Lock the pipe securely in the vise.



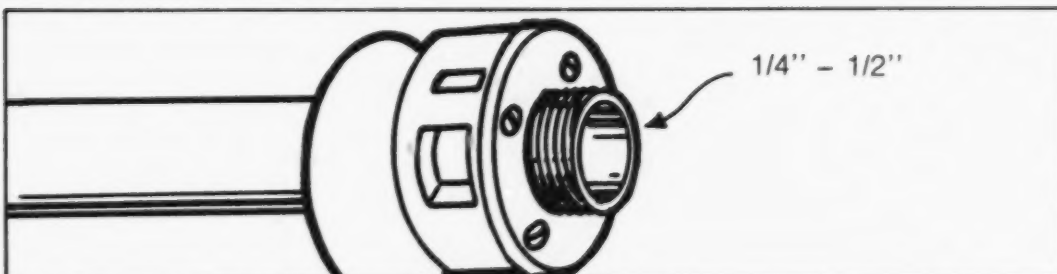
3. With your instructor's help select the proper die size and secure the die in the die stock of the pipe threader. Slide the stock over the end of the pipe with the guide on the inside. Push the die against the pipe with the heel of one hand.



4. Take 3 or 4 slow clockwise turning strokes, pressing the die firmly against the pipe. When enough thread has been cut that the die is firmly started on the pipe, apply a good grade of lard or sulfur threadcutting oil to the die.



5. Continue to turn the stock by downward strokes on the handle. Apply oil often. Continue until the pipe extends 1/4 to 1/2 inch from the die end of the stock.



6. Turn the pipe counterclockwise until the die is free of the cutting thread.

7. Wipe the excess oil and any chips that stick to the threads. The pipe is now ready to make up a joint.

**CAUTION!**

Too much pipe thread is as undesirable as too little.

8. Clean your work area and return tools to their proper places. Show your work to your instructor.

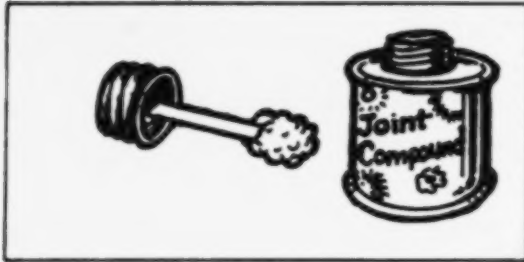


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Working with Steel Pipe

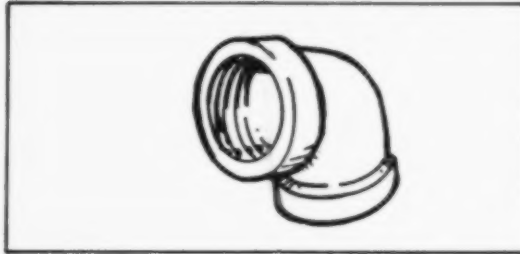
D. Connecting or Joining Steel Pipe

1. Assemble all tools and materials needed to join steel pipe.

Pipe Joint Compound



Pipe Fitting



Safety Equipment

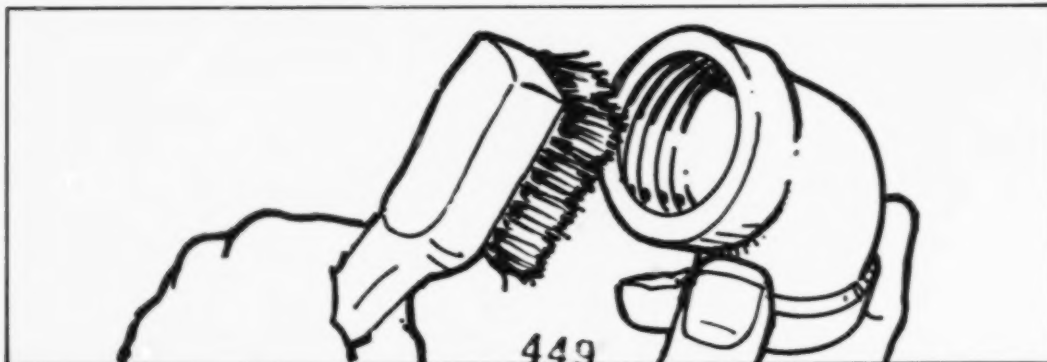


Wire Brush

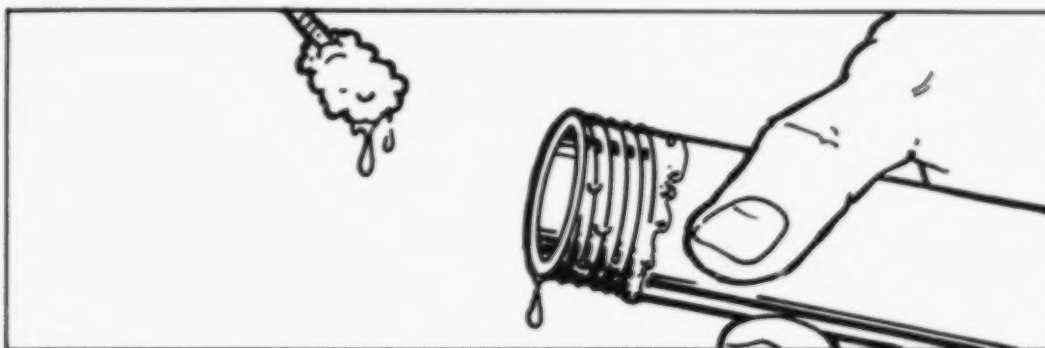


When joining pipes together, fittings are generally screwed to one end of the pipe while it is still in the vise after cutting, reaming, and threading. The assembled pipe and fittings are then screwed into the proper place in the installation. The following steps describe how to make leakproof joints.

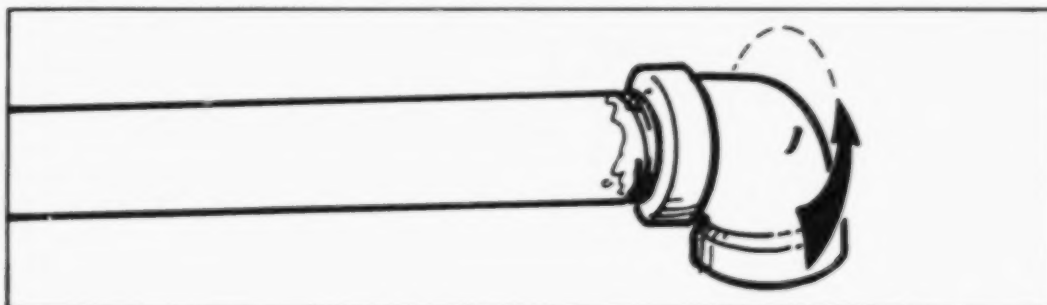
2. Inspect the female thread on the fitting and, if necessary, clean it with a stiff wire brush.



3. Inspect the male thread on the pipe, and if necessary, clean it with the wire brush.
4. Coat the male thread evenly with pipe joint compound. Do not put the compound on the female thread.



5. Screw the fitting on the pipe, making sure that the fitting turns easily for the length of about three threads.



6. Using a wrench, tighten the fitting on the pipe until the joint is tight.



NOTE!

Use the right size wrench for the size of pipe, and never use a length of pipe as an extension handle for added leverage. Use a second wrench to keep an already installed pipe or fitting from turning.

7. Wipe off excess joint compound and paint the exposed threads with an acid-resistant paint.
8. Clean your work area and return tools to their proper places. Show your work to your instructor.

Building Trades - Plumbing
Working with Steel Pipe

Unit Review

Directions: Match each tool with its use by writing the correct letter in each blank.

- | | |
|---------------------------|---|
| ___ 1. pipe reamer | A. Loosens or tightens joints |
| ___ 2. pipe vise | B. Removes inside burr from cut pipes |
| ___ 3. file | C. Holds pipes securely while cutting, reaming or threading |
| ___ 4. tri square | D. Cuts pipe cleanly |
| ___ 5. pipe cutter | E. Marks place to cut pipe |
| ___ 6. pipe threading die | F. Checks squareness of cut |
| ___ 7. wrench | G. Cutting piece used to thread pipe |

Directions: Circle the letter of the best answer.

8. What would happen if a pipe cutter is tightened too tightly against the pipe?
 - a. The pipe will warp.
 - b. The pipe will bend.
 - c. The pipe will not be cut straight.
9. Why must a cut pipe be reamed?
 - a. to remove the sharp edges and burrs
 - b. to make new threads
 - c. to straighten the pipe
10. What is "threading a pipe"?
 - a. cutting grooves in the end of the pipe
 - b. cutting the pipe to the proper length
 - c. smoothing the burrs and rough edges on a pipe
11. When connecting steel pipe on which end do you apply the joint compound?
 - a. the male thread end
 - b. the female thread end
 - c. the male and female thread ends

12. Place the procedures for working with steel pipe in the order they should be done by using A for the first step, B for the second step, C for the third step, and D for the fourth step.

- ___ Select correct tools to do the job
- ___ Ream and thread the steel pipe
- ___ Connect steel pipe pieces
- ___ Measure and cut pipe to proper length

Building Trades - Plumbing
Working with Steel Pipe

Performance Checklist

Student _____ has successfully performed the following steps of procedure.

Measuring and Cutting Steel Pipe	Yes	No	Comments
1. Assembled tools and materials			
2. Measured correct length of pipe			
3. Marked where pipe should be cut			
4. Locked the pipe in the vise			
5. Placed pipe cutter on pipe			
6. Applied cutting oil			
7. Cut pipe with a cutter			
8. Checked squareness of cut			
9. Reamed pipe			
10. Showed work to instructor			
Threading Steel Pipe	Yes	No	Comments
Assembled necessary tools and materials			
2. Locked pipe securely in vise			
3. Placed pipe threader on pipe			
4. Applied threadcutting oil to the die			
5. Turned stock until 1/4" - 1/2" had been threaded			
6. Turned pipe counterclockwise until die was free			
7. Wiped off excess oil and chips			
8. Cleaned work area and put away tools			
9. Showed work to instructor			

Connecting or Joining Steel Pipe	Yes	No	Comments
1. Assembled necessary tools and equipment			
2. Inspected and cleaned female thread on fitting			
3. Inspected and cleaned male thread on pipe			
4. Coated male pipe thread with pipe joint compound			
5. Screwed fitting on pipe			
6. Tightened the fitting on the pipe until the joint is tight			
7. Wiped off excess joint compound			
8. Painted exposed threads with acid-resistant paint			
9. Cleaned work area and put away tools			
10. Showed work to instructor			

Should Move On ☐

Repeat This Unit ☐

Student's Signature/Date

Instructor's Signature/Date